Perspectives for honey production in the tropics

Edited by Marinus J. Sommeijer, Joop Beetsma,
Willem-Jan Boot, Evert-Jan Robberts and Remy de Vries

PERSPECTIVES FOR HONEY PRODUCTION IN THE TROPICS

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Cover:
Beekeeper Mr. Carlos Kendall harvesting honey in Trinidad and Tobago W.I.

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PERSPECTIVES FOR HONEY PRODUCTION IN THE TROPICS

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INTRODUCTION

HARVEST, COMPOSITION, PROCESSING, STORAGE AND MARKETING OF HONEY IN TROPICAL APICULTURAL SYSTEMS

Marinus J. Sommeijer

INTRODUCTION

In this book on various aspects of tropical honey we compiled information of the third NECTAR symposium held in Utrecht 18 December 1995. The general objective of NECTAR, to contribute to the development of beekeeping in the tropics, is pursued by different activities. A major activity is the organisation of symposia and workshops. In 1990 NECTAR organised a workshop on Traditional Bee Management at the Royal Tropical Institute in Amsterdam and in 1993 a symposium on the relation between Tropical Forestry and Apiculture was held at Wageningen Agricultural University. The workshop on Tropical Honeys was organised in Utrecht, in co-operation with Utrecht University.

We realised that surprisingly little is known about the characteristics of tropical honey and about the limiting factors for its production, and we felt that these aspects should receive much more attention. The great potential to produce tropical honey for the world market is still hardly used. The objective of this NECTAR symposium was to bring together existing information on main aspects of honey production in the tropics. The programme dealt specifically with harvest, processing, quality control, and marketing. As a contribution to the development of tropical apiculture this information should become available to people working in the practical field of tropical beekeeping.

The financial support by the Directorate of International Cooperation of the Netherlands Ministry of Foreign Affairs and by the Board of Utrecht University enabled us tot invite specialists from

developing countries. The advantage of this special opportunity is that these specialists can meet and discuss their problems with colleagues all over the world. In addition we invited some honey importers and distributors. The authors of the lectures were invited to submit a text for this book.

After a general introduction by Dr. Eva Crane about outstanding problems with tropical honeys, the first part of this book contains articles about harvest techniques in relation to honey quality in different tropical countries. The composition and quality control of tropical honey is the subject of five following articles. In some of these attention is also given to the medicinal properties that are commonly assigned to honey in tropical countries and to cultural traditions in this respect. The final section of this book contains three articles about the marketing of tropical honey. This is followed by a summary of the discussions and a general conclusion by Joop Beetsma and Willem-Jan Boot.

Honey, the most harvested bee product, is produced by bees using mainly nectar but also honeydew collected from plants. Obviously, floral variations result in rather clear differences in the composition of honeys produced in different ecological regions of the world. The composition of the honey depends not only on the characteristics of the collected nectar. Bees also add enzymes and different bee species apparently vary in their way of processing nectar to honey. Interesting differences appear to occur, e.g. between *A. mellifera* and *A. cerana* honeys.

For the development of tropical honey production, prices on national and international markets are generally high enough to be of interest for tropical beekeepers. Many apicultural development projects or feasibility studies in the tropics have suggested an export potential from these countries allowing for influx of hard currency. Such potential may exist, however it should be realised, already in the first phase of any apicultural project aiming at honey export, that honey quality control by importing countries is an inhibiting factor.

Standards set by importing countries are high, particularly concerning moisture content and the allowance of certain chemical constituents and particles. To assure the buyers that the honey has not been adulterated or that it does not contain agrochemicals, chemical constituents must meet minimum standards.

Another factor in the consideration of development prospects for honey export from a tropical country towards e.g. temperate countries, concerns the comparison of domestic price and international price. In many tropical countries it appears more profitable to sell the honey at the local market. Only when the local demand has been satisfied, the perspectives for export should be considered.

In general, resources for honey production are (still) abundant in the tropics. Many plant species of the tropical vegetations are important nectar resources for bees. In addition, climatic conditions in certain tropical regions do allow for honey harvest nearly all through the year. Although honey production in most tropical regions is influenced by seasonal changes, particularly the alternation of dry and wet periods, productive periods may be longer than in temperate regions of the world. Not only the quantity of honey offers possibilities, also the special characteristics of certain natural tropical vegetations or of tropical crops offering good nectar supply (e.g. "rain forest", citrus, coffee) allow for the development of niche (export-) markets for speciality honeys. Such specialised quality products may lead to valuable economic benefits. The production of tropical honey may be further enhanced because beekeeping in some temperate climate countries seems to decline recently.

We hope that the information compiled in this book on the production, the nature and the marketing of tropical honeys will be of importance to people in the tropics and that it may serve as a contribution to the sustainable use of their rich ecological resources.

INTRODUCTION TO OUTSTANDING PROBLEMS WITH TROPICAL HONEYS NOT PRESENT WITH TEMPERATE-ZONE HONEYS

E. Crane, OBE, DSc.

SUMMARY

Problems in tropical honey-producing countries, due to environmental factors (high temperature and humidity) or due to biological factors as well as data on composition of honey are discussed. High water content, a major problem of many tropical honeys and some methods for removing water are described. Lastly information available in the literature and possible means to enlarge this are discussed and the need for a central data-base on honeys, publications and actual information, is expressed.

INTRODUCTION

Many of the points mentioned will be covered in some detail in other articles in this proceedings, but the effects on honey of environmental factors and of biological factors related both to plants and to bees will be discussed. Because the high water content of many tropical honeys is a major problem, I shall also mention some of the methods that have been developed for removing water from honey.

Producing countries

Problems encountered in tropical honeyproducing countries may have many origins, some are due to environmental factors, others are due to biological factors. Certain tropical honeys still in the hive, fully elaborated by the bees and sealed in the cells, show intrinsic differences from temperatezone honeys: because of the plants, the bees, or the climate and environment, or more than one of these. Most other factors involved are of human origin. The honey handling may be less than satisfactory because funds are lacking for honey handling equipment, or because of a poor infrastructure.

A further difficulty in the producing country may be one of getting information that would help to solve one or other of the above problems, or of knowing whether such information exists that relates to local circumstances. And individual regions of the tropics are subject to very different conditions, are widely separated, and use widely different languages (Table 1).

Table 1: *Factors that can present problems in producing and marketing of tropical honeys.*

1. *Regional environmental factors:*	
climate:	high temperature/rainfall/humidity
2. *Biological factors:*	
(a) honey plants:	native and introduced
(b) bees:	characteristics of tropical bees
	species of honey bees and stingless bees
(c) honey:	composition and properties; toxic honeys
3. *Human factors:*	
(a) bee management in producing honey	
(b) removal of honey from hives (or *A. dorsata* nests)	
(c) handling the honey produced	
(d) removal of excess water	
4. *Factors related to infrastructure. Costs/availability of:*	
(a) water and power supplies	
(b) extracting and processing equipment	
(c) storage and transport of honey	
5. *Marketing factors:*	
(a) honey standards/legislation/adulteration	
(b) retail marketing within the producing country	
(c) costs and difficulties of transport	
(d) requirements established in importing countries	
(e) attitudes of consumers in importing countries	
6. *Lack of information:*	
(a) great distances between different parts of the tropics	
(b) disparity between conditions, and between languages	
(c) finding out which problems have been solved, and how	
(d) identifying problems which have not been solved, and cooperating in their solution	

Importing countries

In general, people prefer the honey to which they became accustomed in early life, and preferences may therefore vary from country to country; Table 2 shows some examples.

Table 2: Some unifloral honeys in order of taste preference, according to tests in different countries.

	Greece (8 honeys)	Switzerland (5)	California (5)
Thymus spp.	1st		
Taraxacum officinale		1st	
Salvia mellifera			1st
Citrus sinensis	5th		2nd
Helianthus annuus	7th	2nd	4th
Rhododendron ferrugineum		5th	
Metrosideros polymorpha			5th
Gossypium hirsutum	8th		

The bulk of honey importing is done by richer temperate-zone countries where people were accustomed to, and prefer, honey from temeperate-zone plants which is often mild-flavoured and light-coloured. Darker and stronger flavoured honeys from the tropics may be more difficult to sell and thus command a lower price. Perhaps the final consumer should receive more information about the tropical honey he purchases.

People of European descent ate more honey per capita because they traditionally regarded honey as a food, rather than as a sweetmeat or medicine as in the tropics. Detailed standards were established in Europe for honey as well as for other foods, and legislation appropriate to temperate-zone honeys was introduced. Some of the criteria in European standards are not equally appropriate to even well produced honeys in the tropics from tropical plants, whether native bees were used, or bees introduced from the temperate zone.

Consumers in humid tropical regions, accustomed to honey with a high water content (and liable to ferment) may well have grown to prefer honey in which fermentation has started. Not all parts of temperate-zone standards are relevant for imports into such regions.

Sources of imports in the past

Few early figures (before the 1950s) are available for world-wide exports or imports, but imports into Britain between 1890 and 1920 (Cowan, 1928) did not come from the same countries as in the 1990s, when China dominates the export market; Table 3 gives the imports into Britain.

Table 3: Import figures for Britain between 1890 and 1920.

Range 1891-1903 Country	Imported tonnes
Chile	180 - 587
British West Indies	62 - 576
Spanish West Indies	171 - 369 (1891/93 only)
USA	161 - 406
Australasia	0 - 180
France	45 - 82
Canada	2 - 59 (1896/1903 only)

Maximum 1915-1921 year	country	Imported tonnes
1917	Chile	1645
	France	165
1918	USA	7148
	Cuba	1787
	other countries	1507
1920	Dutch West Indies	304

There was a consistent increase in imports from British West Indies, and a decrease in those from the USA.

Environmental and biological factors

It seems important to distinguish between problems with tropical honeys intrinsic to those properly produced in the hive, and problems due to human factors somewhere along the line. The two are likely to have different solutions, and I shall consider them separately.

The main environmental stress factors in the tropics are high temperatures and high humidities. High temperatures can reduce or prevent nectar secretion in plants. In the hive, bees control the temperature closely only within the brood nest, not outside it, and stored honey may become so hot that it is damaged. Some solutions to this problem lie in the proper placing, shading and painting of hives.

Where the atmospheric humidity is very high, bees may be unable to reduce the water content of honey sufficiently to prevent fermentation, and Figure 1 shows the relation obtained by Martin (1958) between the water content of legume honey and the relative humidity of the air at room temperature, probably about 20°.

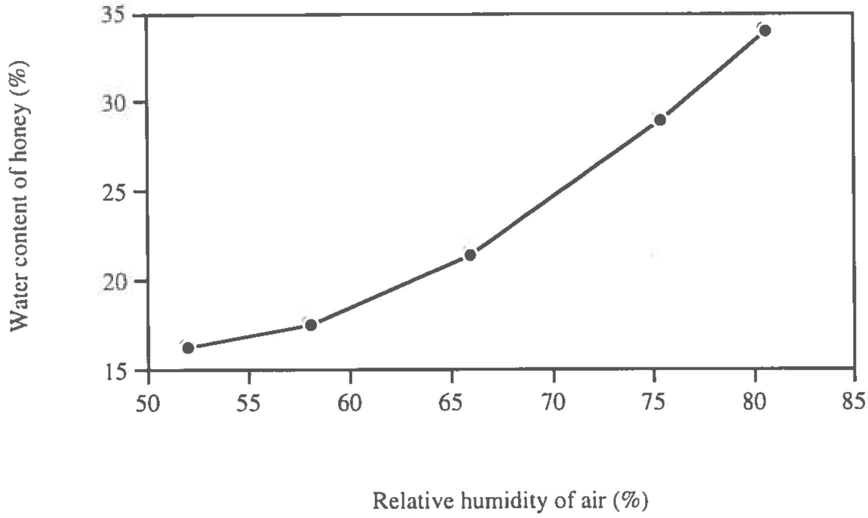

***Figure 1**: Relation between water content of legume honey and relative humidity of the air at room temparature (Martin, 1958).*

`Honey stored and sold in temperature zones must have a water content low enough to prevent fermentation. However, the critical water content is not the same for honeys from honey bees and stingless bees, and may not be the same for honeys from different species (or perhaps races) of honey bees. (In 1939 Moreaux found that different colonies might seal honey in the cells at slightly different water contents). We do not yet understand the factors which govern such differences.

In Yucatan, Mexico, Nevin and Elizabeth Weaver (1981) took samples of *Apis mellifera* and *Melipona beecheii* honeys from hives, and handrefractometer readings gave water contents of 19 to 21 % for the honey bees and 26 to 27 % for the stingless bees; the authors added the comment that the *M. beecheii* honey 'does not spoil'. In

the article by Mr. de Bruijn in this proceedings, some suggestions about the reasons for this are made. Many characteristics of honey produced by the same bee species vary according to the plant sources, which affect its chemical composition, its pollen content, and possibly its yeast content. A few honeys are toxic - normally because of an active agent in the plant of origin - and Table 4 lists some of those in the tropics and subtropics. I was told in Nepal that honeys from certain *Rhododendron* species are not toxic, and examples are also listed in the Table 4.

Table 4: *Some honeys from plants in tropical and subtropical latitudes reported toxic or harmful to man.*

Plant	Toxicagent etc.	Reference
Compositae:		
Senecio jacobaea	pyrrolizidine alkaloids	White (1981)
Ericaceae:		
Rhodondendron spp. e.g.		
R. anthopogon		Kafle (1984); Sharma (1984); Crane (1975)
R. ponticum	andromedotoxin	Crane (1975)
NOT *R. arboreum*		as *R. anthopogon*
NOT *R. campanulatum*		as *R. anthopogon*
NOT *R. thomsonii*		as *R. anthopogon*
Solanaceae:		
Datura metel	scopolamine	White (1981)
? other *Datura* species		
Hyoscyamus niger	atropine	Crane (1975)
Euphorbiaceae:		
Euphorbia seguieriana	carcinogens (identified)	Upadhyay *et al.* (1980)
Hevea brasiliensis	irritant	Percy (1986)

We know rather little altogether about the differences between honeys produced from the same plant by different bee species, and different bees often forage on different plants.

Unfortunately many honeys that have been studied were removed from the hive in unrecorded circumstances, and also extracted, handled, stored and transported in unrecorded circumstances. Human factors may therefore have played a significant part in determining the characteristics of these samples.

Human factors affecting the water content of honey

Honey may contain excess water because the beekeeper removed it from the hive before the bees finished elaborating it, and thus before they removed all the water they could. I will cite three examples.

First, in Saskatchewan in Canada, some large-scale beekeepers (using temperate-zone *A. mellifera*) now choose to remove full honey supers several times during the summer, before the combs are completely sealed. They then apply high-technology methods to reduce the water content of the honey (Murrell & Henley, 1988).

Second, with *A. mellifera* in parts of south-east Asia, a system of frame-hive beekeeping was developed in which individual combs containing unsealed honey were removed, extracted and immediately replaced. This system required minimal capital for purchasing hive boxes and frames; it needed no facilities for storing empty combs safe from wax moths, and beekeepers also reported benefits from using small colonies. But the water content of the unsealed honey was high; for example in Vietnam the average was reported as 22-23% for *A. mellifera* honey and 25-26% for *Apis cerana* honey (Mulder, 1988). Much progress has since been made in Vietnam, reported in the contributions by Ms. Tuyet Huynh and by Mr. Tam, in these proceedings.

Third, when harvesting *Apis dorsata* honey at natural nest sites, it is virtually impossible to take only the sealed parts of the comb, and any unsealed honey is also put in the collecting vessel.

Unsealed honey may be unfinished in many ways, because the bees have not completely elaborated it - for instance by incorporating enzymes and inverting sucrose - as well as by evaporating water. Such defects are not remedied by removal of water after combs are harvested. The honey may well not conform to certain standards, and one might argue that it is not true honey.

We are not concerned here with the Canadian method of maximizing honey production by deliberate harvesting of unsealed honey; and improving the quality of *A. dorsata* honey is not our first priority. But it seems important to me that honey for exporting to temperate zones should not be extracted from unsealed combs, because the excess water can then be removed only with difficulty from bulk honey, which I shall mention later. Most people would agree that the water content of honey removed from the hive should not be reduced by more than 1 or 2%, and some would argue that removal of any water is unacceptable because the process may also remove aroma components.

Data on the composition and properties of tropical honeys

I first encountered the great lack of data on tropical honeys in the early 1970s when preparing a book on honey. In the 1980s, when compiling the Directory of important world honey sources, we hunted for further data but found rather few. More studies have been published since then, and in the seven years 1988-1994 Apicultural Abstracts reported at least one study on the honeys of 21 tropical countries.

Table 5: *Number of countries with studies on honeys per continent.*

continent	number of countries
Asia	6
Africa	5
Central America and Caribbean	6
South America	4

Patricia Vit Olivier (1988) analysed 500 honey samples collected from different parts of Venezuela in 1985-1987, and her thesis includes individual analyses.

With regard to honeys from specific plants, rubber trees (*Hevea brasiliensis*) are grown in a humid environment, and rubber honey is one of the most troublesome with regard to water content. In 1978 Fernando in Sri Lanka reported a water content of 25%, and in 1983 Nair in South India gave the range 22% - 30%; both results were for honeys from sealed combs of *A. cerana*. Mr. Tam will report later on sealed *A. mellifera* honey from longan (*Euphoria longan*) in Vietnam, for which he found a water content of 23.5%. Laude, et al (1991) in the Philippines gave the following water content of honeys from different bees for the numbers of samples indicated:

Table 6: Water content of honeys for different bees in the Philippines.

species	number of samples	averaged percentage water content ± s.d.
A. mellifera	27	19.5 ± 1.5
A. cerana	9	22.0 ± 3.7
"commercial"	14	20.0 ± 3.2
A. dorsata (nests?)	5	23.1 ± 2.3

Removal of water from honey

There was much discussion about methods of removing water from honey at the meeting on "The Asiatic hive bee: apiculture, biology and role in sustainable development in tropical and subtropical Asia", held in Malaysia in 1988. In view of the lack of collected information on the subject, I wrote a Chapter for the Proceedings based on 40 or more publications. This part of the text is updated in Bee Werld, 1996, no 3.

In 1987 Paysen in the USA published a useful summary of options for removing water from honey or, as he describes it "to dry wet honey", and Figure 2 shows his summary diagram.

His first option is to enable the bees to remove all excess water, of "help bees do it". All other options are human actions: "do it yourself".

Firstly, water can be removed from either sealed or uncapped combs before the honey is extracted. Treating sealed combs needs less effort, but treating uncapped combs is faster. For over 50 years some beekeepers have fairly easily removed water from sealed honey combs stacked in their supers in a warm ventilated room, prior to uncapping. A dehumidifier was used, and temperatures and air flow were very carefully controlled.

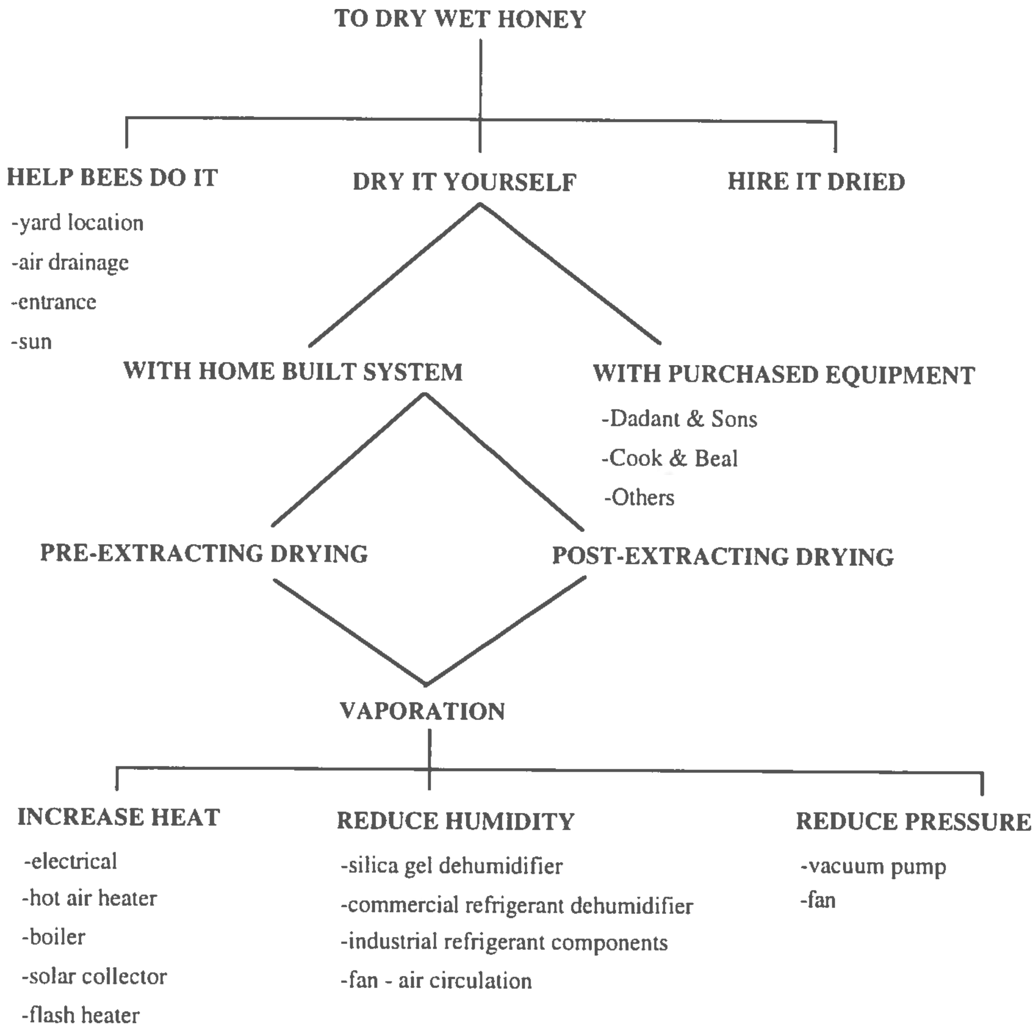

Figure 2: *Options for removing water from honey (Paysen, 1987).*

Secondly water can be removed from bulk liquid honey after extraction, but this is much more troublesome and less efficient because water can leave the honey only from its surface. So the honey must be spread out in thin layers, and dry air passed over its surface and then removed, carrying water vapour with it. Heating the honey speeds up the process, but honey is damaged by heating for too long a time or at too high a temperature. Heating the dry air speeds up its absorption of water. So does decreasing the air pressure, and low-pressure systems (often called vacuum systems) can function at lower honey temperatures which damage the honey less, but they are expensive to operate.

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Paysen calls these two alternatives "increase heat" and "reduce pressure", and he suggests another alternative: "reduce humidity", that is to use disiccants (drying agents). Small-scale experiments by T. Carmencita in Indonesia were described at the 1994 meeting of the Asian Apiculture Association. Silica gel and calcium oxide were used as desiccants, with about 1.8 kg of honey; the silica gel was reusable, but not the calcium oxide.

Information available and how it could be enlarged

During the past 45 years the journal *Apicultural Abstracts* has reported publications on tropical honeys; most were on honeys of individual countries, and I have referred to some recent ones. There were fewer reports on honeys from specific plants. Certain data on tropical honeys from individual plant species were collected in my *Honey: a comprehensive survey* (1975) and *Bees and beekeeping* (1990), and in the *Directory of important world honey sources* (Crane, Walker and Day, 1984). Phadke studied a number of Indian honeys between 1962 and 1968. Recent decades have seen a great increase in the palynological study of honeys (determination of plant source by identifying pollens in the honey).

Table 7: *Tropical countries or regions with legislation (L), standard or codex (S) based on honey to be sold. (IBRA, 1977; Crane, 1990).*

Africa		Americas	
Tropics		Tropics	
Central Africa	S	Bolivia	L
Kenya	LS	Brazil	L
Liberai	S	Central America	S
Madagaskar	L	Colombia	S
Malawi	L	Costa Rica	S
Mozambique	S	Dominican Republic	L
Tanzania	L	Ecuador	L
Zambia	LS	El Salvador	S
Zimbabwe	S	Guatamala	L
		Honduras	LS
		Latin America	S
		Mexico	LS
		Nicaragua	S
		Panama	L
		Peru	L
		Uruquay	L
Subtropics/temp.		Subtropics/temp.	
Egypt	LS	Argentina	L
Morocco	L	Canada	LS
South Africa	L	Chile	LS
		Usa	LS

Table 7 (contd.)

Asia		Europe	
Tropics		Temperate	
India	LS	EU	S
Philippines	S	Austria	LS
Singapore	L	Belgium	LS
Sri Lanka	S	Bulgaria	S
		Cyprus	L
Subtropics/temp		Czech Rep.	LS
China	S	Denmark	LS
Korea	LS	Finland	L
Iran	S	France	LS
Israel	S	Germany	LS
Japan	S	Greece	LS
Oman	S	Hungary	S
Saudi Arabia	S	Iceland	L
Taiwan	S	Ireland	LS
Turkey	S	Italy	LS
		Luxembourg	LS
Oceania		Netherlands	LS
Subtropics/temp.	L	Norway	L
Australia	L	Poland	S
New Zealand		Portugal	S
		Romania	S
		Russia	S
		Spain	LS
		Sweden	LS
		Switzerland	LS
		UK	LS

Anyone who considers exporting honey needs to know about legislation and standards (codex) in the country concerned. In 1977 IBRA published a list, and updated information (Crane, 1990) shows that 69 countries, 26 in the tropics and 43 in the subtropics and temperate zones, now have either legislation or standards (Table 7).

Only perhaps 20 tropical countries have set up national honey standards, and other countries should be encouraged to do so, basing them on standards existing elsewhere but not necessarily copying them.

Differences have been reported between certain constituents and properties of honeys from tropical and temperate zones. Tropical honeys may have a higher water content, acidity, and liability to ferment.

Dr. Kerkvliet adds to these a higher antibacterial activity, and a higher pollen content (which may result from the bees' storage of pollen in cells of combs from which the beekeeper subsequently extracts honey). Ash content, pH and electrical conductivity are more questionable. It would be useful if these and other differences could be further assessed, and attempts made to understand reasons for them, in terms of plants, bees, environmental conditions and other factors. Honey quality control, see also other articles in these proceedings, is based on the composition and properties of the honey, so real differences are especially important.

With regard to general problems, information on tropical honeys is very scattered, and it would be most valuable if a central data base could be established to give access to both publications and actual information on these honeys.

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HARVEST TECHNIQUES IN RELATION TO QUALITY OF PRODUCTS

HONEY HARVESTING AND PROCESSING TECHNIQUES IN RELATION TO BEEKEEPING METHODS AND TYPES OF HIVE (*APIS MELLIFERA ADANSONII*) IN NIGERIA.

Marieke Mutsaers

SUMMARY

Many honey types are found in Nigeria, both from traditional and modern hives and honey hunting. The very dark amber "black African honey" is valued for its medical qualities, mainly in traditional rural communities. White or light amber honeys are valued as foodstuff or sweetener, mainly in the modern urban society.
Quality, colour and taste of honey are affected by several factors at different stages between foraging and processing.
- During foraging honey quality is mainly determined by the nectar sources. Tropical multifloral honeys should primarily be classified according to their vegetational zone as forest, savannah and sahel honey. Honey harvested from a particular type of vegetation has a common taste. This taste is not necessarily determined by a single nectar source. Differences are caused by the air humidity which affects nectar secretion and bee behaviour.
- The quality of the honey is affected by the type of comb in which the honey is stored: new combs or combs that contained brood and pollen before. The last type of honey is darker and has a stronger taste probably also due to the propolis used by the bees to polish the former brood cells.
- During harvesting the quality of the honey is affected by the amount of smoke used. Horizontal layering of combs in top-bar hives and traditional hives often involves in addition the extraction of some pollen.
- Among other things, labour, extraction percentage and clearness of honey are compared between leaking and hand-pressing, mechanical

pressing and centrifugal extraction of whole combs from top-bar hives.
- The amount of pollen in honeys of many different origins is determined.

INTRODUCTION

Honey is and was used as a foodstuff and - mixed with soaked and sour millet - made into mead in northern Nigeria (Lewicki, 1974). In Yoruba-speaking south-western Nigeria, however, honey appears to be more important as a medicine and a ceremonial food than as a foodstuff. Customers - should I say patients - would come from far away to buy a good quality honey from my bee farms (1988-1993) and paid a good price for it. In the Netherlands the role of honey is also changing to the medicinal one as it may have been before.

It is therefore important to pay attention to the medicinal role of honey and its quality as well as to other hive products (pollen loads, bee bread, propolis, beeswax, bee milk, bee brood, bee venom, and in the future insect antibiotics) of honeybees and stingless bees. The medicinal use of these products and the preparations made of them is generally called apitherapy.

I am happy that in this symposium attention is paid to this subject, as it is of major importance to particularly the tropical world (Kómoláfé, 1993). Kóláwolé Kómoláfé, a medical practitioner in Nigeria and expert in traditional herbal medicine, which includes the use of tree bark and bee products, is here with us today to testify to the importance of apitherapy in Africa.

In this paper I will discuss honey quality, taste and pollen content in relation to beekeeping methods with *Apis mellifera adansonii* in different vegetational zones and different types of hive in West Africa. Many of the data are from beekeeping in my own farms or projects mainly in south-western Nigeria, in forest, savannah and sahel

(Thomas, 1992) vegetations. Traditional beekeepers in different parts of the country were interviewed.
There is no essential difference between traditional and modern beekeeping in seasonal colony management. However, different types of equipment for beekeeping, harvesting and processing are used. They are discussed where necessary.

BEEKEEPING IN NIGERIA

Honey production in relation to seasonal development of honeybee colonies

To have an understanding of the seasonal dynamics of honeybee colonies in areas unknown by the modern (new or foreign) beekeeper it is important to carry out regular hive inspections and make detailed notes on the observations. Seasonal peaks in honey flow can be determined by regularly weighing a number of hives. A combination of hive inspection and weighing provides a wealth of information. A work schedule for beekeeping and harvesting could be based on it (Mutsaers, 1991c).

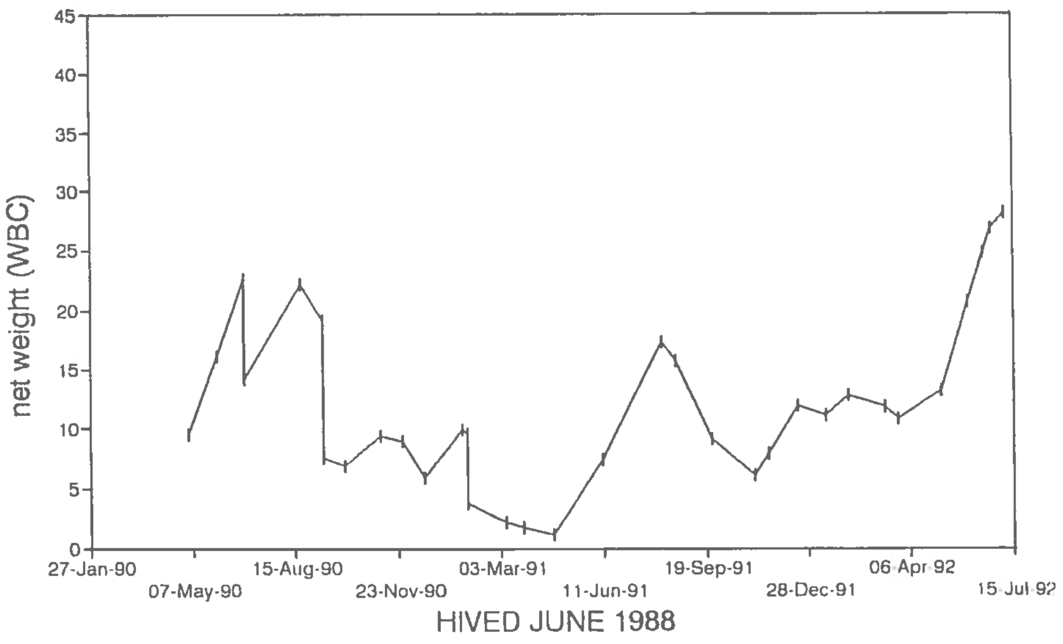

Figure 1: Ayepe, plot 1, hive 1

From 1988-1993 honeybee colonies were kept in top-bar hives. During a period of three years occupied top-bar hives were weighed at monthly intervals on a flat-top scale. Subtraction of the known weight of the empty hive with empty top-bars results in the weight of bees and combs (WBC) (Figure 1 and 2). In the graphs the harvesting of honey combs is indicated by a vertical line representing the fall in weight (Mutsaers, 1992a).

The weight of bees and combs in a hive of 90 litre ranged from 3 up to 45 kg. If the weight fell under this critical value the colony would either abscond or not produce the next season (see Figure. 1). This can be avoided by leaving a few honey combs next to the brood nest at harvesting and - of course - by not harvesting combs with brood (Mutsaers, 1992b).

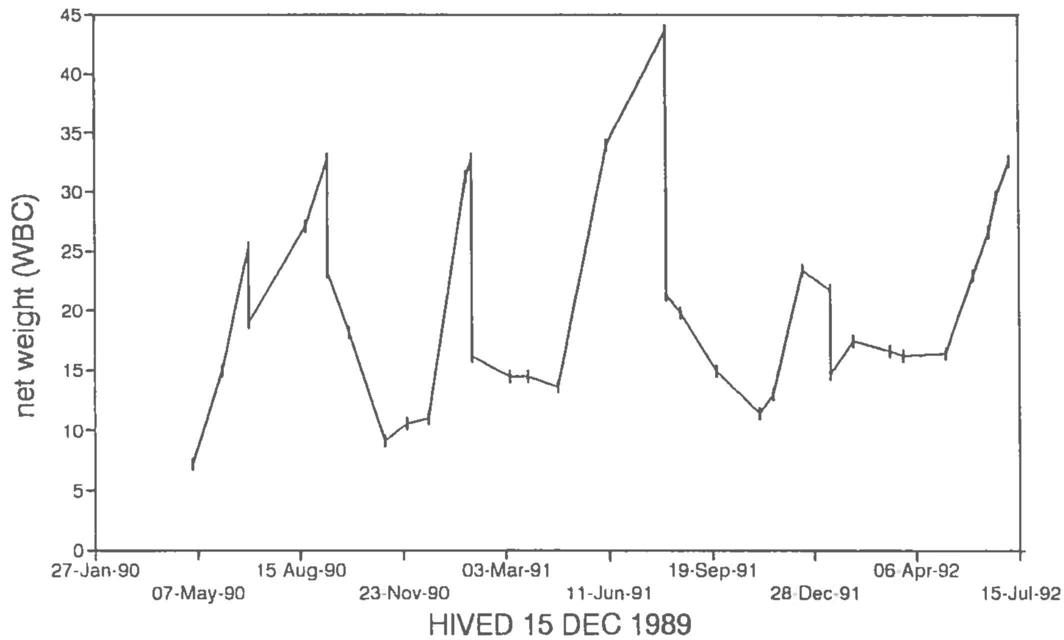

Figure 2: Ayepe, plot 1, hive 2

Honey combs need to be harvested before the peak of the honey flow (see Figure 2). In case of movable combs from which the honey is extracted with a centrifuge, the empty combs can be returned to the hive or be given to another hive at harvesting. After this peak empty combs will be an adverse condition for the colony and should therefore not be returned to the hive but be processed (Mutsaers, 1992b).

Traditional hives, harvesting and extraction methods

Traditional hives are e.g. pots, gourds, reed hives and bark hives, all with fixed combs (Jessen, 1967; Villiéres, 1987; Himsel, 1991; Mutsaers, 1993a). All combs are harvested or only the honey combs, depending on local tradition and type of hive. Several types of hive can be opened at the back side, which gives an opportunity to take out honey combs but leave the brood combs intact. Brood combs are next to the entrance of the hive, while honey combs are at the far end from the entrance.

Harvesting takes place in the night, with new moon and a torch is used for smoking. If all combs are harvested and the combs with bee bread, brood and bee milk are extracted together with the honey combs, this will result in a mixed product, which may also contain wax and propolis. Eva Crane (1990) gives the nutritional value of this 'whole food'. Harvested honey combs are eaten as such, soaked in a calabash or pail and hand-pressed, sometimes after several days of soaking.

Honey quality, colour and taste

There is a wide variety of honey types, from traditional hives, honey hunting, and modern hives.

Honey may be clear, light amber and thick if obtained directly from a beekeeper, but bought in the market it is often dark of colour, not so clear, not very viscous, with bee hairs and other particles present. The taste is sometimes sour and smoky. High quality honeys are kept aside for special customers and probably never reach the public markets. The same variety of honeys may originate from top-bar hives as well, although there is a tendency towards a better quality and with lower pollen content as we will see later.

The very dark amber 'black African honey' is said to be 'richer' or more 'powerful', and it is valued for its medicinal qualities, particularly in traditional rural communities, while the white or light amber honeys are valued as a foodstuff or sweetener, particularly in modern urban society. For colour classification of tropical honey I refer to Smith (1960). Honey is also used as a ceremonial food, for instance at a naming ceremony (Mutsaers, 1993a). Honey in the cities is often bought from stores which sell imported, for instance Mexican honey or even a locally manufactured fake honey.

The quality, colour and taste of honey depend on several factors which affect the honey at different stages between foraging and processing:

1. at foraging
2. in the bee hive
3. at harvesting
4. at processing

The first stage depends on vegetation, bee season, size of the colony, weather and honey flow. The second stage depends on the bee season, the weather, but also on the time the honey stayed in the comb and the type of comb, non-brood comb or former brood comb with remaining bee bread and membranes in the cells (Table 1).

Table 1: *Honey quality determining factors at four stages*

Vegetation and bee determined:		Beekeeper determined:	
at foraging	in the hive	at harvesting	at processing
bee season	bee season	bee season	type of comb
honey flow	weather	way of smoking	ripeness of honey
nectar source	type of comb	selection of combs	uncapping
vegetation zone	time in comb	neatness	processing method
weather	colony size	transport	sieving
colony size			

Added to these are the beekeeper's action at harvesting: selection of combs, type of smoker or torch, amount of smoke used, carefulness and neatness. All the foregoing conditions still undergo - after transportation - a fourth set of influences, those at processing: removing bees from the combs, selection of combs (separation of new and old combs), selection of comb-parts (cutting away of brood and bee bread), uncapping and the processing method: leaking and hand-pressing, mechanical pressing and centrifugal extraction, and finally the way of sieving (Table 2).

Table 2: *Comparison of processing techniques of honey from top-bar hives*

	leaking & hand-pressing	mechanical pressing	centrifugal extraction
labour (pers.)	1	1	3
time (days)	1-3	1-2	1/2
extraction (%)	50-70	70-80	70-90
uncapping	no	no	yes
straining	sac[1]	sac[1]	sieve
clearness of extracted honey	very clear	less clear	clear
quantity extracted at one time	10-20 kg	20-30 kg	20-50 kg
price equipment	S 10-20	S 250	S 500
price honey/kg	S 5	S 5	S 5
advised for annual quantity of	< 100 kg	< 200 kg	> 500 kg

[1] A cheese cloth sac was used for practical reasons

Honey quality determining factors at foraging: vegetation and nectar source

Honey quality is primarily determined by the nectar source or plant species. For instance nectar rating, sugar value of nectar, duration of honey flow, honey potential for many plant species from all over the world are given in Crane et al. (1984). Honey seasons in Nigeria are given by several beekeepers (Attfield, 1967; Jessen, 1967; Obi (Ikediobi et al.), 1984; and Mutsaers, 1991b & 1992a). However, tropical multifloral honeys should primarily be classified according to their vegetation zone as forest, savannah and sahel honey. There is a common taste in honey from a particular type of vegetation which is not necessarily determined by a single nectar source. Forest honey is usually white to amber in colour, but could be 'black' if it remained in the hive for a long time. It usually resembles the honey from temperate climates in taste and other qualities. Savannah honey is dark white to medium amber, but could also be 'black'. The taste is musty and could only be called 'savannah taste'. Sahel honey is usually not very viscous and resembles molasses both in colour and in taste.

Determination of plant species by microscopic analysis of pollen in these honeys may help in determining the effect of different plant species (providing nectar, honeydew and pollen) on the organoleptic properties of honey from the various vegetation zones.

With a given vegetation zone major differences in floral vegetation exist. For instance in the forest zone a banana plantation, which has an all year round high nectar yield (Kiew and Muid, 1991; Mutsaers, 1993c), has a bee season which is different from the season in a secondary forest and provides a different honey. A radius of 500 m to 1 km is most important for bee foraging (Mutsaers, 1993b). Within the different vegetation zones the bee seasons are generally the same, but local differences are determined by the proximity of predominant crops and the richness of the vegetation. From year to year there are differences caused by the weather. The weather is mainly determined by the predominant wind direction. Wind from the south brings a humid weather type and wind from the north brings an extremely dry sahel type of weather, called harmattan. Air humidity largely influences the nectar secretion of different plant species but also bee behaviour. The effect on honey flow, which is the result of nectar secretion of the vegetation and foraging behaviour of the bees, is enormous (Mutsaers, 1992a). The effect of a harmattan period can be seen in November and December 1991 in both graphs of weight of bees and combs (Figure 1 and 2).

Honey quality determining factors in the bee hive

In a good honey flow, before the peak of the season, the colony usually builds new combs to store honey, as the existing combs are still needed for brood rearing, while after this peak, when brood rearing has decreased, incoming nectar is stored in combs which contained brood and bee bread before. The cells of these brown or black combs still contain parts of the cocoon and larval skins of the brood which emerged. This influences the quality of the honey. The honey appears to be darker and stronger in taste. Propolis which was used by the bees to polish the inside of the cells for brood rearing may have penetrated the membrane. This propolis and the membrane itself could be responsible for this strong 'tawny' and 'membranous' taste. The after-peak honey is also more viscous probably because it has been more thoroughly processed by a larger number of bees. In a humid type of weather open and even sealed honey, particularly in the smaller colonies, absorb water from the air. This results in fermentation and will eventually change the taste of the honey. Black and sour honey result from these conditions.

A larger quantity of honey, which is stored in a short period of time, i.e. in a good honey flow, is usually of a very good quality.

Honey quality determining factors at harvesting

Honey from top-bar hives is harvested at dawn or dusk, preferably in a weather type that is favourable for a minimum of smoking. This is better for the colony and also prevents too much smoke penetrating the cell capping. Honey combs are harvested by transferring preferably full, and obligatory fully ripe honey combs, attached to top-bars, into an empty top-bar hive. Harvesting whole combs sets a condition for clean honey. Cutting off combs at harvesting attracts large numbers of bees onto the harvested combs, which cannot easily be swept off. They stick to them as well as dust and dirt. Unsealed honey combs are - also for the benefit of the colony and for future production - best left in the hive. Open honey absorbs smoke and gives a smoky taste to the final product. Unsealed honey is not yet ripe and will therefore increase the moisture content of the whole lot if processed with it.

The horizontal layering of combs in top-bar hives and traditional hives implies that the top and the bottom of the hive are represented in the same comb so that honey combs often contain some bee bread underneath. In vertically layered hives bee bread is found in the lower brood chambers. It also happens, though rarely, that honey is stored on top of remaining bee bread.

Harvesting before the peak of the honey flow results in exclusively pre-peak honey, while harvesting after the peak means that either a mixture or a selection is harvested. However, a selection can still be made at processing. Honey harvested before the peak, tends to be less

thick with a higher moisture content. It can be extracted more easily than the more viscous end-of season honeys.
A harvest of 15 to 25 kg from one hive, for instance about ten combs of each 2 kg, can be expected to be of higher quality than 20 combs with 1 kg each. These may also contain more bee bread.

Extraction percentage and honey quality determining factors at processing

At the place of processing first some uniform combs would be selected to prepare cut-comb honey. These should not be former brood combs because this affects the taste of the honey. Cut-comb with fluid honey was put in flat plastic containers and crystallised cut-comb honey was cut into pieces for direct consumption or wrapped in cellophane . The other combs were uncapped and extracted with a hand-operated centrifuge (Mutsaers, 1991a). Broken combs and sometimes - for the sake of the experiment - whole combs were extracted in three different ways: leaking and hand-pressing, mechanical pressing and in a frame with fine mesh gauze or a sac in the centrifuge (see also Krell, 1991). Centrifugal extraction of small pieces of broken comb was not very efficient and mechanical pressing was preferred.

The extraction percentage, i.e. weight of the extracted honey as a percentage of the weight of the whole comb, is higher with any type of processing if honey is unripe and in case the combs contain no cocoons and larval skins. A higher surrounding temperature results in a slight increase in extraction. Of course, the extraction percentage is also higher when using combs which are completely filled with ripe honey compared to combs which are partly filled.

Bee brood and bee milk are completely extracted together with honey irrespective of the extraction method used and result in a higher moisture and pollen content. Bee bread is probably less extracted than bee milk and larvae extracted when pressing, but after some days of soaking it will come out of the cells. When using centrifuge it stays behind in the comb, unless it had been stored with honey in the same cells. The soaked bee bread will appear in the honey as lumps (see Table 3).

Moisture content was regularly monitored with a honey refractometer. It was found to be satisfactory (lower than 20 %). Honey extracted from sealed harvested honey would not ferment during storage in closed bottles.

In case of using too much smoke it will penetrate the cappings and also will be absorbed by the open honey. In that case the honey to be pressed could also be uncapped to reduce a smoky taste. Open honey should therefore not be harvested or should be processed separately. Also the honey extracted from cappings should be kept separate from centrifuged honey.

A comparison was made for extraction of whole combs using leaking and hand-pressing, mechanical pressing or centrifugal extraction. Comparison is made with respect to labour, i.e. number of persons, time, i.e. number of days, extraction percentage, uncapping or not, straining through cloth or a sieve, clearness of the extracted honey, the quantity which could be easily extracted at one time, the price of the equipment and the annual quantity of honey for which the equipment is advised (Table 2).

It is assumed that local honey has been leaked and handpressed. It may have been soaked sometime before processing, but since leaking and hand-pressing of top-bar hive honey combs takes some days also, there should not be too much difference in the results. This only applies to carefully and neatly harvested and processed honey. However, malpractises are not uncommon. Stephen Adjare gives a detailed description of the way a so called honey tapper obtains a high extraction percentage from feral-colony honey combs (Adjare, 1984).

POLLEN COUNTS IN WEST-AFRICAN HONEY

Counting of pollen was done by weighing 10 gr. of honey which was diluted and centrifuged following Maurizio's method for quantitative microscopic analysis (Louveaux et al., 1978) with slight modifications. This resulted in the following pollen counts.

Nectar: One sample of 10 gr. of undiluted nectar (*Spathodea campanulata*) contained 12,500 pollen.

Table 3: *Pollen count per 10 grams of nectar (1 sample) and honey from movable-comb hives (42 honey samples of West Africa)*

	leaking & hand pressing	mechanical pressing	centrifugal extraction
nectar:			
Spathodea campanulata	12,500		
Trichilia apiaries[1]:			
KTB honey (1 sample)[2]	600	2,500	6,900
KTB honey (4 samples)	3,800		
	6,300		
	6,900		
	83,700		
KTB honeys (4 samples)		17,600	
		35,200	
		360,000	
		1,200,000	
KTB honey (28 samples)			
range			6,300-5,000,000
median			60,400
Concentrated bee bread in honey			93,100
Same honey without lumps of bee bread			17,600
Honey from other projects:			
Nigeria (Benue State?	88,000		
Umudike (Langstroth hive)	49,700		
LSH (Langstroth hive) from honey super Rép. du Bénin			1,600,000
KTB Nigeria (Nguru)	0.2 million		
KTB Ghana	0.8 million		
KTB Cameroon	0.8 million		

[1] Trichilia Apiaries, bee farms in south-western Nigeria

[2] samples from the same lot

Movable-comb hives: Pollen counts per 10 gr. of top-bar hive honeys extracted with different equipment are compared in Table 3. The pollen counts for top-bar hive honeys from my own farms (forest and savannah honeys) range from 600 to 83,700 for leaking and hand-pressing; 2,500 to 1.2 million for mechanical pressing and 6,300 to 0,5 million, with a median of 60,400 for 28 samples, for centrifugal extraction. Honeys from both types of vegetation showed low and high pollen counts and are therefore not listed separately.

One lot of forest honey was divided in three parts and extracted in different ways. This resulted in pollen counts of 600 pollen for leaked and handpressed honey; 2,500 for mechanically pressed honey and 6,900 for centrifuged honey. In this case mechanical pressing gives a lower pollen count than centrifugal extraction, which is not consistent with results from the other material.

Concentrated bee bread, extracted when using a centrifuge contained 93,100 pollen. The same honey sampled without lumps of soaked bee bread contained 17,600 pollen.

Honey from other projects (movable-comb hives) in Nigeria, Cameroon, République populaire du Bénin, and Ghana (forest and savannah honeys), ranges in pollen count from 49,700 to 1.6 million. The Umudike sample from eastern Nigeria (forest) is from a Langstroth hive with a honey super and was leaked and handpressed (Ikediobi et al, 1985) and contained 49,700 pollen, while the Bénin sample (savannah) is also from a Langstroth hive with a honey super but was extracted by centrifuge. It contains 1.6 pollen per 10 gr. The Nguru top-bar-hive sample from Nigeria, leaked and handpressed, with 0.2 million pollen, could be classified as a sahel type of honey (Table 4).

Table 4. Pollen count (million) per 10 grams of local honeys West Africa (23 samples)

country	Pollen count (million)
Mali	
Sibi	0.5
Bamako	1.2
Sibi	2.3
Farana	2.7
Bamako-Segou	4.6
Bénin	
Ajeregbe	0.8
Nattitingou	1.8
Bassila	3.4
Gbanlin	3.4
Cameroon	
Oku	0.8
Nigeria	
Nguru (KTB)	0.2
Ado-Ekiti	0.2
Ondo State	0.2
Jos	0.3
Oyo	0.3
Ondo State	0.5
Baba Ode	0.8
Warri	1.3
Ago Are	1.7
Baba-Ode	1.7
Nsukka	1.8
Nsukka	3.8
Baba Ode	6.1

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Locally bought honeys: Locally bought honeys (from markets and road-sides) originate from traditional beekeeping and honey hunting. They may be mixed with stingless bee honey from feral colonies (Kómoláfé, pers. comm.) or be adulterated with syrup. The samples from Nigeria, Cameroon and République populaire du Bénin contained 0,2 to 6,1 million pollen per 10 gr.

CONCLUSION AND DISCUSSION

Extraction of honey combs with leaking and hand-pressing, mechanical pressing and hand-operated centrifuge resulted in good final products. Leaked honey is very clear. Mechanically pressed honey is usually less clear than handpressed and centrifuged honey.

Using leaking and hand-pressing the extraction percentage will be lower than when using mechanical pressing and centrifugal extraction. Beekeepers with a production of more than 100 and less than 500 kg honey combs annually, from any type of hive, are therefore advised to use a honey press. As a centrifuge is very expensive it could be added at an annual production of more than 500 kg, and only for a beekeeper with movable-comb hives. This saves time even if operated by one person.

The pollen counts of centrifuged honeys, harvested and processed as carefully and neatly as in the Netherlands (by myself or under my supervision), are often, but not always, in the same range as those of temperate-zone honeys. Higher counts may be due to a different method of beekeeping, particularly type of hive and harvesting technique rather than processing techniques. Higher counts are probably not caused by differences in honeybee race, climate and vegetation, as low pollen counts (< 10,000 per 10 gr.) are not uncommon. However, further study is needed for firm conclusions. More results of honey supers would also be interesting.

Pollen counts from locally bought honeys are much higher than those of movable-comb hives. This is probably also caused by different harvesting techniques and non-selection of combs rather than by processing techniques. Similar processing techniques were used with honey combs from movable-comb hives resulting in much lower counts. Selected honey combs from fixed-comb hives would probably show similar results.

Improved beekeeping and harvest techniques for all types of equipment, both fixed-comb and movable comb hives, will no doubt improve production and honey quality.

However, adjusting quality standards to higher pollen contents would be fair and form a step forwards towards appreciation of tropical honeys.

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HONEY QUALITY AND MARKETING IN GHANA

Kwame Sarkwah Aidoo

SUMMARY

In Ghana, traditional beekeeping and honey hunting are still in existence, and have been part of the people's culture since several generations. Honey hunters exploit the honey bee (*A. m. adansonii*) as well as various species of stingless bees for honey. Methods of harvesting and processing always have a direct relationship to the quality of the honey. Traditional beekeepers still rely much on harvesting and processing methods like those used by honey hunters. These include total/partial colony destruction prior to comb removal from the nest, separation of honey combs from brood, and straining/squeezing/burning or heating honey combs to extract the honey. Beekeepers using top-bar hives have adopted straining of the honey. Honey quality is also related to the time of the year in which the honey is harvested, and to the ecological origin of the honey within the country.

Peak production of honey occurs between February and April, and a minor peak occurs in November and December. The honey is mainly produced for the local market. The various strategies that exist for marketing honey in Ghana will be discussed and strategies for improvement will be outlined.

INTRODUCTION

Geography

Ghana is a small West African country with a land area of 239 km^2 and a population of about 14 million people. On a map of Africa, Ghana stands almost half way on the Atlantic coast from Dakar in Senegal to the Southern Cameroon's. The country lies between Latitude 4 and 11 degrees North of the Equator and the Greenwich

Meridian passes through its entire length. Ghana shares borders with Burkina Faso (North). Cote d'Ivoire (West) and the Republic of Togo (East). The southern end is covered by the Gulf of Guinea in the Atlantic Ocean.

Climate, Vegetation and Honey Production

The amount of rainfall varies over the country and follows a seasonal pattern. The wettest part of Ghana (South-West) receives more than 1900 mm of rain a year. The driest (South-East Coastal Plains) receives a mean annual rainfall of a little less than 750 mm. Two main patterns of rainfall are recognised: with a single maximum found in the North of the country: and with a double maximum, typical for the Southern parts. Areas with a single rainfall maximum have their rainy season from about May to August. Areas with a double maximum lie on or near the coast and have rains twice a year, from May to August, and from September to early November.

Just like rainfall, vegetation in the country varies from one part to the other. The major vegetation types from south to north include the coastal bush and grassland, the rain forest, the moist semi-deciduous forest, interior wooded savannah, and Mangrove forest. All ecological regions of the country support the West African honey bee, *Apis mellifera adansonii*, the honey of which is of great commercial importance. In addition, various species of stingless bees, some of which produce quite substantial amounts of honey, are found in abundance.

The moist semi-deciduous forest is second to the interior wooded savannah in terms of honey production. However, the greatest potential for beekeeping and honey production is found in a well marked agro-ecological zone between the moist semi-deciduous forest and the interior wooded savannah in the middle of the country (Adjare, 1987). There are large areas with important bee forage plants such as the Baobab, *Adansonii capitata*, various species of Acacias, the Shea butter, etc. Trees such as cashew nuts and mango are cultivated and provide a good source of forage for bees as well.

In the moist semi-deciduous forest, foraging activity of bees is at its peak during the dry seasons when most tree and other plant species bloom. Honey harvests are at the end of the dry seasons. Numerous tree species that are important forage sources for bees are cultivated either on plantations or as mixed cultures in farmers small holdings. Coconuts, oil palm, coffee, rubber, banana, mango, and citrus are cultivated. Numerous wild trees, shrubs and other plants are also important to bees. These include members of *Ceiba*, *Terminalia*, *Elaeis*, *Julbernardia*, *Bidens* families, etc.

Background to Honey Production

Modern beekeeping or beekeeping with improved methods is a recent undertaking in Ghana. Even though honey is important in the culture of the people, its main source of honey has been honey hunting and traditional beekeeping. In Ghana, honey hunters, like elsewhere in the world, use various methods that allow them to overpower a colony of bees in a wild nest and collect the honey. Feral nests of both honey bees and stingless bees are exploited for this purpose. A typical honey hunter is equipped with a glowing torch of fire, usually made from dry palm fronds, to burn as many as possible of the colony's workers who otherwise defend their nest. With most of the colony's defenders eliminated, the hunter removes all the combs from the cavity. Brood combs are thrown away and the honey combs are processed for honey. In most cases the empty combs are thrown away into the bush. What happens to the raided colony is any body's guess: total destruction of the colony's population and the cavity itself or a much reduced colony that absconds with or without a queen. Thus honey hunting practices are not sustainable. In most cases they are destructive to the environment since they may cause wild fires.

Traditional beekeeping practices in Ghana are a step ahead over honey hunting. Three main types of traditional beekeeping are distinguished by the kind of hives that are used: the clay pot of the Ekumfis in central Ghana, the Borrassus log hives of the Adaklus in South-East Ghana, and the basket hives of the Winowas in North-East Ghana. All three traditional hives are fixed comb types. While some traditional beekeepers use the same harvesting practices as the honey hunters, others use smoke and herbs to drive away the bees from the combs, and remove only honeycombs for processing. Processing methods for honey by traditional beekeepers and honey hunters will be discussed and related to quality.

Improved or modern beekeeping in Ghana started in 1979 as a result of promotional work initiated by the Apicultural Promotion Unit of the University of Science and Technology Kumasi, led by S. Adjare. The Kenyan Top-bar hive was adopted and is now used by most beekeepers. A recent introduction is the Saltpond-hive (a top-bar hive designed by the author for the local honeybee *A. m. adansonii* under an IFS-research project). The top-bar hives have been found to be most appropriate for the local honey bee. However, about 2 % of hives used by beekeepers are Langstroth frame hives.

HONEY QUALITY

The beekeeping industry in Ghana is a young one. Legislation or laws related to beekeeping and the production of bee products are non-existent. The Ghana Beekeepers Association is growing into a strong body which will define standards in terms of approved practices and quality products for consumers. In many parts of Europe, especially in the EU, there are clear spelt out regulations that have specific guidelines in the production and sale of honey. The EU-legislation on honey is known as 'Harmonisation on the laws of the Member states relating to Honey' and is derived mainly from the proposed Codex Alimentarius of 1969. The following contents are clearly spelt out:

Reducing sugars:	- not less than 65 % (calculated as invert sugar)
Moisture content:	- not more than 21 %
Sucrose content:	- not more than 5 %
Water-soluble Solids:	- not more than 0.1 %
Mineral content (ash):	- not more than 0.6 %

Diastase activity index: - not less than 8
Hydroxymethylfur-
furaldehyde (HMF): - not higher than 40 mg/kg

The question is: should EU-importers of honey adhere strictly to these specification without taking into consideration the differences that occur in the properties of honey as a result of geographical origins?

Scientific analysis of representative honeys in Ghana has had little study. Detailed laboratory study of properties of hive products that are important in international trade need to be carried out. This will set out standards for producers and consumers. In Ghana and many parts of West Africa such investigations have not been carried out. In most cases the reason is that the international trade in bee products in the sub-region is yet to be developed; marketing is mainly internal. In addition, most countries lack the specialist manpower and facilities to carry out such studies because many governments do not realise the potentials of beekeeping in their economies.

Between 1992 and 1993, I made an attempt to look at one important property of honey related to quality: moisture content. Forty mature honey samples extracted by straining and pressing were collected from beekeepers throughout the country. Twenty other samples were collected from sealed combs in ten Top-bar hives in southern Ghana in November 1993. Using a field refractometer, it was observed that beekeepers' mature honey had a mean moisture content of 21.38 % with a range of 17.6 to 24.0 %. Honey from sealed combs had a mean moisture content of 21.32 % with a range of 20.0-22.7 %. Two interesting observations came out in this simple study. The low moisture-honeys were those harvested between February-April when the country experiences the dry Hamattan season, and samples with a moisture content as high as 23.0 % did not ferment. There is a great need for further study of our rich honey which I believe can compete well with those from other countries.

AGRO-ECOLOGICAL REGIONS AND QUALITY

The combination of climate and vegetation has produced four distinct agro-ecological regions in Ghana: the coastal bush and grassland, the rain forest, the moist semi-deciduous forest and the interior wooded savannah. In each region, different groups of plant species flower and produce nectar at different periods of the year, thus providing abundant food sources for bees. Therefore, honey obtained from one region at different times of the year varies in terms of colour, flavour and sometimes taste. Generally, honey samples in Ghana show great variations between golden, light amber, amber, dark amber and dark.

Honey obtained from the coastal bush and grasslands, the rain forests and the moist semi-deciduous forests are usually golden to amber; with distinct flavours. The best of Ghana's honey is from this region and is obtained from foraging on the giant Silk-cotton Trees: *Bombax buonopozense* and *Ceiba pentandra*.. These trees belong to the family of *Bombacaceae*. An amber-coloured honey with characteristic flavour and taste is produced from December to February. Harvests form the interior wooded Savannah produce strongly flavoured honey with dark amber to dark colours. Sometimes honey form the coastal bush and grasslands carries a slight tint of bitterness. It is believed that this is due to nectar from the neem tree (*Azadirachta indica*) and from *Vernonia amygdalina*.

In all regions of the country major honey flows occur during the dry seasons. In the North of the country, where the influence of the dry Hamattan winds are severe (December-February) honeys harvested tend to have a relatively lower moisture content: sometimes as low as 17.0%. In some parts of Southern Ghana, which experience a double maximum in rainfall, there is a minor honey flow during the light rains in August and November. This leads to some harvest in November-December. Honey obtained during this period has a relatively higher moisture content. The total honey production per year for Ghana is unknown and is difficult to estimate. On average a typical Kenyan Top-bar Hive produces 35 kg of honey per year in two harvests.

HONEY HANDLING AND QUALITY

The methods used in extracting and processing honey from the combs have a profound effect on its quality. Honey hunters in the northern parts of the country will put the honey combs in a big bowl with a metal mesh at the bottom. Embers of fire are placed on the combs which set the wax burning. A receptacle is placed under the mesh to collect the honey below. The honey obtained in this way is burnt, black and sooty. However, in Southern Ghana, honey hunters squeeze the honey out of the comb with bare hands (Figure 1). Some traditional beekeepers process honey similarly. Honey obtained with these methods has a high moisture content and therefore ferments easily within a short time when stored. This may also result from adding brood combs during processing.

Most beekeepers who have adopted improved practices strain or press the honey combs. Only sealed (mature) honeycombs are removed from the hives. The majority of members of the Ghana Beekeepers Association strain their honey by crushing the combs into small pieces with a kitchen knife (Figure 2). The crushed combs are placed over a nylon mesh tied over a big receptacle usually a plastic bucket (Figure 3). The set up is covered with a polythene sheet and allowed to drain overnight. It can also be placed in the sun for about 2 to 3 hours, to hasten the drainage of the honey. The drained honey is strained through a nylon mesh or cheese cloth to obtain a clean, clear product. The honey so obtained is of high quality. Honey is mainly kept in air-tight plastic containers of varied volumes. Most beekeepers and honey hunters know of the hygroscopic nature of honey and therefore store it in sealed containers.

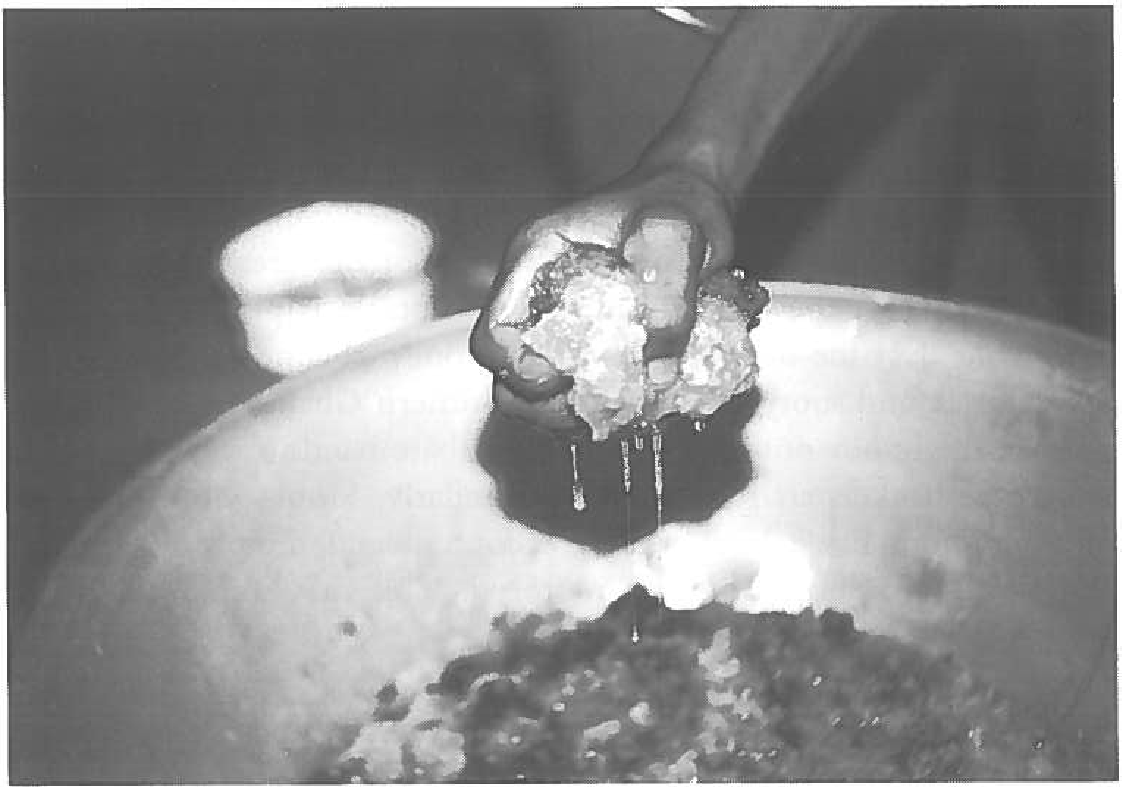

Figure 1: *Squeezing of honey combs during extraction.*

***Figure 2:** Crushing of honey combs with a kitchen knife.*

***Figure 3:** Straining of crushed combs using a nylon mesh.*

HONEY MARKETING

The internal market

Many people regard honey as a medicinal product rather than as a sweetener. A lot of people in Ghana know about the health qualities of honey and take it regularly. Traditional medicine men or herbalists always recommend their preparation to be taken with honey and also use it as a component of their preparations. The demand for honey is therefore very high within the country and throughout the year. The honey supply often falls short of demand. After the peak season's harvest in February-April, there is abundant supply of all grades of honey in the market. These are consumed in no time, however, and by July the product becomes scarce. It is estimated that honey hunters contribute about 60 % of the honey supply into the market, traditional beekeepers about 25 % and modern beekeepers about 15 %.

Sales outlets

The local price of honey, like everywhere in the world, is higher than what is offered in the world market. Good quality honey from a beekeeper is a premium product and commands a good price. Small-scale beekeepers (5-20 hives) sell directly to friends and other consumers. Usually, buyers come along with their own container, and a beer bottle (l kg) or a Coca-Cola bottle (0.5 kg) are the units of measurement.

The price of honey is between US$ 2 and 3 per kilo. Large-scale producers (up to 100 or more hives) package their honey in large 35 kg or 50 kg plastic containers for selling to dealers who sell to consumers in the cities and big towns. Some beekeepers however pack their honey in one kilogram bottles for selling in supermarkets. A few beekeepers use jars (glass or plain plastic) to package good quality honey for top class supermarkets and hotels in the country.

There are many sale outlets for honey from honey hunters and traditional beekeepers. They may sell direct to other members of the community or village, or pass it on to honey dealers. These are mainly women who go from village to village to buy whatever grade of honey available directly from the producers. Bulk honey is thus assembled and moved to marketing outlets in the cities. The dealers transport the bulk honey to small-scale distributors in the urban centres. Three groups of retailers of honey in the urban centres are distinguished: peddlers who carry honey about in two gallon plastic containers, and equipped with a funnel and a beer bottle as a unit of measure, women who sit at vantage-points in the city and attract customers to buy their honey, and traditional herbal medicine sellers who have stalls in the market place and include honey as part of their general wares (Figure 4).

Figure 4: *A stall of a traditional herbal medicine seller with a display of honey in a plastic gallon and beer bottles.*

Honey of stingless bees

Various species of stingless bees occur in Ghana and are hunted for their honey. By the local people honey of stingless bees is regarded as a product with high medicinal value, far greater than that of the honey bee. It is highly demanded by medicine-men and herbalists who regard its high potency in the treatment of asthma, colds, eyedisorders, etc. Therefore, the price is high. In fact it is measured and sold by the teaspoonful for as much as 0.50 US$. Most times of the year it is not available since only honey hunters produce small quantities. The culture of these bees has yet to be developed.

International markets

Ghana has a great potential for the production of high quality honey. Most parts of the country are covered with rich, undisturbed natural tropical forest. Large tracts of cacao (*Theobroma cacao*) plantations exist which are shaded by mixed tree species most of which provide abundant food sources for bees. Cultivated tree species like citrus, mango, avocado, coconut and cashew all offer forage for bees throughout the year. However, honey production in the country is mainly for local consumption. The export trade in honey and other bee products has not been organised due to the fact that production of high quality honey is in the hands of few beekeepers who keep ten hives on average. Another reason is that the world market price of honey is far lower than what the beekeeper obtains in the internal market, bearing in mind the strict adherence to quality standards dictated by overseas buyers. However, it is interesting to note that sometimes honey packed in Europe is imported and sold by some supermarkets. The price of such imported honey is very high: sometimes four times higher than that of the local types.

HONEY ADULTERATION

Honey is highly demanded and highly priced in Ghana. Supply always falls short of demand. It is against this background that dealers of honey, mainly the middlemen and retailers sometimes exploit consumers to their advantage. Water may be added to the honey and the mixture may be heated over fire until it boils. Burnt cane sugar dissolved in water may be added to the honey which is then boiled. The unfortunate situation is that most consumers cannot distinguish a pure honey from a bad one. In certain rural communities clean strained or pressed honey from a beekeeper is regarded as an inferior product, because they only know honey as black and sooty, and with suspension of wings and legs of bees!

CONCLUSION

The potential for the production of high quality bee products, especially honey and beeswax, exists abundantly in Ghana. Given the right organisation and motivation in terms of good export prices, beekeepers can produce high quality products that will be of high demand in the international market. The honey produced from vast areas of undisturbed and unpolluted natural tropical forests can be specially packed for overseas markets to give additional income to rural beekeepers.

The Ghana Beekeepers' Association (GHABA), which now has a membership of about one thousand, can become a body equipped with support and facilities to develop an industry capable of attaining high production levels of top quality bee products to meet both internal and external markets. Most of GHABA's activities over the years have aimed at improving the production efficiency of its members and a project is in preparation to standardise beekeeping within the country. Details of this project will include standardisation of equipment, improvement of management practices, harvesting, handling and packaging of bee products. This training project will equip members to improve their productions and to put top quality bee products into both the internal and external markets. This we hope will improve the beekeepers' income and hence their standard of living.

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HONEY PRODUCTION, QUALITY CONTROL AND MARKETING IN TANZANIA

Dominic V.N. Kihwele

SUMMARY

Honey production in Tanzania is dependent on smallholder beekeepers who mainly use barrel hives for *Apis mellifera scutellata* Over 95 % of beekeeping in Tanzania is practised in Savannah forests which are popularly known as Miombo woodlands. The rest is carried out in what one would call *Api-Agro-Forestry Systems* around homestead, in banana plantations and coffee farms, for example, whereby shade trees are used for hanging hives.

Meliponiculture is also practised on a small scale in Kilimanjaro, Arusha, Iringa, Mtwara and Singida Regions. The local price for honey from stingless honeybees is about five times higher than that for stinging honeybees because of higher medicinal values.

The average productivity per *A. m. scutellata* colony per year using traditional hives is 15 kg. honey and 1 kg. beeswax. Productivity for stingless bees varies with species or varieties. For the larger variety, whose natural habitat is in hollows of trees, productivity ranges between 6 to 12 kg. honey for the variety locally known as *Nyori* (Kichagga) or *Lega* (Kihehe), using log or box hives. Smaller variety, *Ndw~Zi* or *Pai,* produces a few grams up to 2.5 kg depending on the volume of the "nest" and the size of the colony under natural conditions.

Quality control methods for honey include: (a) Harvesting honey from remote *Miombo* woodlands, away from pesticides; (b) Harvesting honey without using fire (by some beekeepers); (c) Straining honey using gadgets made of stainless materials such as bamboo strainers combined with skimming off beeswax particles; (d) Storing honey in stainless containers such as clay pots, leather bags,

bark and wooden containers, etc; (e) Keeping in cool rooms, which are thatched with grass so as to protect the honey against denaturing by the heat of the sun.

Marketing of honey (and beeswax) is carried out by Beekeepers' Co-operatives, Private companies and individuals in both local and export markets. Prices are set by the market forces.

The paper also discusses the problems of obtaining figures for actual national annual honey production and the agreed formula used for calculating the same using beeswax export figures.

INTRODUCTION

Honey production in Tanzania is a traditional art which has been practised since time immemorial. Available reports show that over 99 % of the honey produced in Tanzania comes from traditional beekeepers who use barrel hives to harness the native honeybees, *A. m. scutellata* The type of hives used encourages the production of both honey and beeswax. It is estimated that over 95 % of these bee products come from remote beekeeping areas which are situated in Savannah forests which are popularly known as *Miombo* Woodlands.

The rest comes from *Api-Agro-Forestry Systems* around homesteads, in and around farms, for examples, in banana plantations and coffee farms whereby shade trees are used for hanging hives. During honey harvesting season in *Miombo* Woodlands, beekeepers live near their beekeeping areas, in Beekeeping camps which may be 50 km or more away from villages or residential areas. On the other hand, honey production from stingless bees is carried out by beekeepers within their homestead.

Primarily, honey quality control in Tanzania is the responsibility of the beekeeper which starts right from the designing of the hive, selection of apiary site, colony management-especially during honey harvesting, straining and storing it. Good co-operation between beekeeping extension workers and beekeepers has shown improved quality of both honey and beeswax. Local traders and exporters of honey and beeswax have also encouraged beekeepers to improve the quality of the bee products by offering higher prices for better quality.

HONEY PRODUCTION IN TANZANIA

Who produces honey?

Traditional beekeepers who use mainly barrel hives are responsible for the production of honey from both stinging and stingless honeybees. Field observations show that over 99 % of the honey and other bee products (beeswax, propolis, etc.) come from these beekeepers. Most beekeepers are experienced old men, of over 50 years of age (Kihwele 1984).

Kihwele found that the young people do not join in the beekeeping industry because they believe that beekeeping is associated with witchcraft which is an art practised only by old people. However, in recent years some women (Kihwele et al 1992 and 1993a) and young men and boys (Kihwele et al 1995) have joined the beekeeping industry and successfully carried out honey (and beeswax) production.

Where is honey produced?

It is estimated that over 95 % of the honey produced in Tanzania comes from remote areas in *Miombo* Woodlands. Table 1 shows distance from living areas to various beekeeping camps in typical *Miombo* Woodlands in Chunya District (Kihwele et al 1993b).From the table it can be seen that it is quite possible to produce honey which is free from contamination by agricultural pesticides due to remoteness of the beekeeping areas. About less than 5 % of the Tanzanian honey comes from farmland where *Api-Agro-Forestry Systems* are common practices. Examples of such systems exist in farms for maize, banana, sisal, sunflower and coffee whereby shade trees are used for hanging hives which form what sometimes are called "Tree Apiaries".

Table 1: Average Distances from Villages to Beekeeping Camps in Chunya District (Kihwele et al 1993b).

Village	Average distance (in km)
Bitimanyanga	40
Mafyeko	35
Isangawana	25
Mtanila	30
Lupatinga	30
Mamba	25
Gua	30
Kapalala	30

When is honey harvested?

Knowledge on the season for honey harvesting is essential for improved quality and quality of hive products because it is not easy to access the status of combs when using barrel hives. If the beekeeper harvested honey to early (i.e. a few weeks before the appropriate date), the following are some of the problems which would happen.

1) Honey which is not yet ripe would be harvested; such honey would easily go bad due to fermentation.
2) Brood which would still be in many combs would be damaged during harvesting because it is not easy to carry out selective removal of combs when using barrel hives. The presence of brood during honey harvesting would entail much work for the beekeeper to separate brood from honey and keep them in different containers. However, it is possible to carry out selective removal of combs when using Split Type Log Hives.
3) The amount of honey harvested would be less because lots of it would still be in the field (in the form of nectar) yet to be collected by foragers.

On the other hand, if the beekeeper started harvesting honey some weeks after the appropriate period, the following are some of the problems which the beekeeper would face:

1) Many empty combs would be found in hives due to honey engorgement by colonies which prepare themselves for seasonal or annual migration. This would lead to reduced amount of honey harvested.
2) Late harvesting of honey coincides with annual bush fires which can destroy both the honeybees and the hive products.

It has been found that most beekeepers are aware of the losses which they would face if they started harvesting honey too early or too late. To avoid such losses they have learned to use special indicators which help to determine the appropriate date with one or all of the following indicators (Kihwele 1984):

1) Rainy season ends and dry season starts.
2) Flowers (e.g. Lupepete in Kibungu Tribal Language in Chunya District) become dried;
3) Field flowers wither, especially Muva (Julbernardia globiflora), and seeds form in the pods;
4) Field crops ripen, e.g. millet;
5) Kansimba/Ilamata (in Kibungu) herb sticks on clothes;
6) Intensity of sound made by foraging bees in fields decreases significantly;
7) Activity of foragers at the hive entrance ceases or decreases significantly;
8) Dead drones are found at the hive entrance and on the ground near the hive;
9) Bees cluster outside the hive;
10) Much propolis is seen at entrance and crevices of the hive;
11) Hive weight increases significantly.

How much honey is produced?

The amount of honey produced per colony has a positive correlation with:

1) increased colony size (number of foragers) .
2) increased volume of hive.
3) increased number of bee-fodder plants.
4) good weather conditions.
5) improved bee management.

Productivity of *A. m. scutellata* colony, using log or bark hives ranges from a few kilograms to about 50 kg of honey per season. However, the national average productivity is 15 kg. honey and 1 kg beeswax per colony per season. Records show that a beekeeper in Babati District (Magugu Village) has been able to produce up to 100 kg of honey per colony per year while using frame hives and harvesting honey every one or two weeks (Kihwele l990a). Some beekeepers have been able to produce 30 to 45 kg honey plus 2 to 3 kg beeswax per colony per season while using Tanzania Top-Bar Hives (TTBH).

Prices for the hives:

Log Hive	Tsh	2,000 - 5,000;
TTBH	Tsh	8,000 - 12,000;
Frame Hives	Tsh	12,000 - 18,000.

It has been difficult to obtain figures for the annual national production of honey due to lack of data on the amount of honey consumed locally at
household levels, in brewing and pharmaceutical industries, etc. However, for planning and budgeting purposes, the amount of honey produced in Tanzania may be calculated using the following assumptions;

1) Using field observations in high potential beekeeping areas such as Tabora, Mbeya, Tanga and Singida Regions, the amount of beeswax exported through legally known channels is about 35 %. The remaining 65 % can be accounted for by some amount wasted (either thrown away through ignorance or due to lack of effective marketing system); some amount used by cobblers, candle making etc., and some going into black market across the border where it is used as a medium of exchange in barter trade for household commodities (Kihwele and Nnyiti 1985).
2) The National production ratio of beeswax to honey is maintained at 1:15 which is the average colony production ratio using log or bark hives (Kihwele 1983).
3) Since beeswax is mainly produced for export and its packaging and transportation are fairly simple, it is assumed that the amount exported is fairly constant, and kept at 35 %.

Thus available beeswax export figures (from Customs Department and or Central Bank) can be used to calculate the amount of honey produced in the country by using the ratio and export percentage as shown in (b) and (c) above, respectively (Table 2).

Table 2: export figures for honey and beeswax for 4 years :Tanzania Export Earnings 1991/92 - 1994/95

Year	Honey		Beeswax		Total
	Tonnes	US $	Tonnes	US $	US $
1991 / 1992	123.00	221.400	696.00	2,088,000	2,309,400
1992 / 1993	31.90	31.216	569.50	1,522,739	1,553,955
1993 / 1994	78.00	71.540	123.80	237,882	309,422
1994 / 1995	19.10	25.837	120.40	371,635	397,472
Total	252	349.993	1,509.70	4,220,256	4,570,249

Source: MNRT: 1991, 1992,1993,1994, 1995

Beekeeping constraints

The following are some of the constraints faced by beekeepers which may adversely affect the quality and quantity of honey and other hive products.

Lack of appropriate bee protective clothing

The majority of beekeepers do not have bee protective and it has been found that about 20 % of the honeybee colonies are not harvested every year due to the stinging impact (Kihwele 1984). The quality of honey may bee spoiled by the fact that beekeepers who do not use protective clothing carry out harvesting so hurriedly that the honey may be spoiled.

Many beekeepers harvest honey at night when bees have less tendency of stinging. Working in darkness may also affect the quality of honey. Available reports show that in order to avoid much stinging by bees some beekeepers harvest at night with minimum clothing or completely naked. Beekeeping extension workers are encouraging beekeepers to make and use bee protective in order to protect themselves against bees stings and improve the quality and quantity of honey.

Introduction of compulsory tobacco cultivation

Some Districts (example Chunya) introduced compulsory cultivation of tobacco by every farmer (including beekeepers). Beekeepers are complaining that tobacco industry is destroying the bee-forage and good areas for establishing apiaries in *Miombo* Woodlands. Some beekeepers claim that their honey and beeswax production has dropped by over 50 % since the introduction of compulsory tobacco cultivation.

Special beekeeping economic studies have shown that beekeepers are so much concerned with the conservation of the beekeeping areas (*Miombo* Woodlands) that they are requesting the Government to give them title deeds (ownership) for "Beekeeping Forest Reserves" or "Beekeeping Reserves" (Kihwele et al 1993b) in order to control destruction of woodlands by indiscriminate cutting of trees for tobacco cultivation, pitsawing and charcoal burning.

Destruction of colonies by honey badgers
Many studies have been carried out which show that the Honey Badger (*Nellivora capensis*) is detrimental to the beekeeping industry (Kihwele et al 1993b, Kihwele 1984). Some beekeepers who did not use wire to hang their hives experienced significant losses; some up to 100 % loss from destruction of colonies by honey badgers.

Other methods of combating honey badgers are: hanging each hive from a wooden hook; piling thorny branches around the base of the Tree-Apiary; wrapping a sheet of metal around the tree trunk; setting a special trap at the base of the Tree-Apiary.

Low hive occupancy
The problem of low hive occupancy discourages beginner beekeepers and other investors in the beekeeping industry. The "Let-alone" method of beekeeping which do not encourage bee breeding and package beekeeping leaves over 60 % of the beekeeper's hives unoccupied by bees throughout the year.

The problem is aggravated by the Swarming (absconding, migratory and reproductive) behaviour of the *A. m. scutellata* which may account for 20-30 % unoccupancy of the beekeeper's hives. The beekeepers have tried to minimize the problem by baiting their hives with beeswax, special herbs, propolis, etc.

Lack of adequate appropriate containers

Lack of adequate appropriate containers adversely affects the quality and quantity of honey produced. Many times beekeepers have been forced to harvest only 5 to 10 % of their colonies due to lack of storage containers during harvesting. Containers made of stainless materials such as wood, bark, straw, skin, clay pot and plastic pails are used to hold honey combs during honey harvesting. Larger drums (with capacity of 300 kg) are used for storage. However, these containers are not readily available to the beekeepers. Beekeepers are being encouraged by extension workers to develop sustain ability of availability of appropriate containers by making the same using locally available materials.

HONEY QUALITY CONTROL IN TANZANIA

The best quality of honey is said to be that of Sealed honey in the comb. Any handling or processing of honey which maintains that quality or causes minimum "damage" to the quality should be encouraged and recommended.

The following are some handling and processing methods, used by beekeepers, which are recommended for honey quality control:

Honey harvesting methods

Figure 1 shows the appropriate honey harvesting method for a split log hive. Beekeepers are encouraged to observe the following:

- Start harvesting honey at the right time by observing the indicators described in section about time of harvesting. Some beekeepers recommend to start two weeks after the last rainfall (beginning of dry season). Field experience has shown that there is no brood during that time.
- Smoky smell is avoided by using minimum smoke.
- Maintain two containers: one for accidentally removed brood combs and another for honey combs.

- Absorption of water from the air by honey is avoided by covering the honey containers with tight lids, e.g. 20 litre Plastic Pails from Amboni Company which are popularly used by beekeepers.

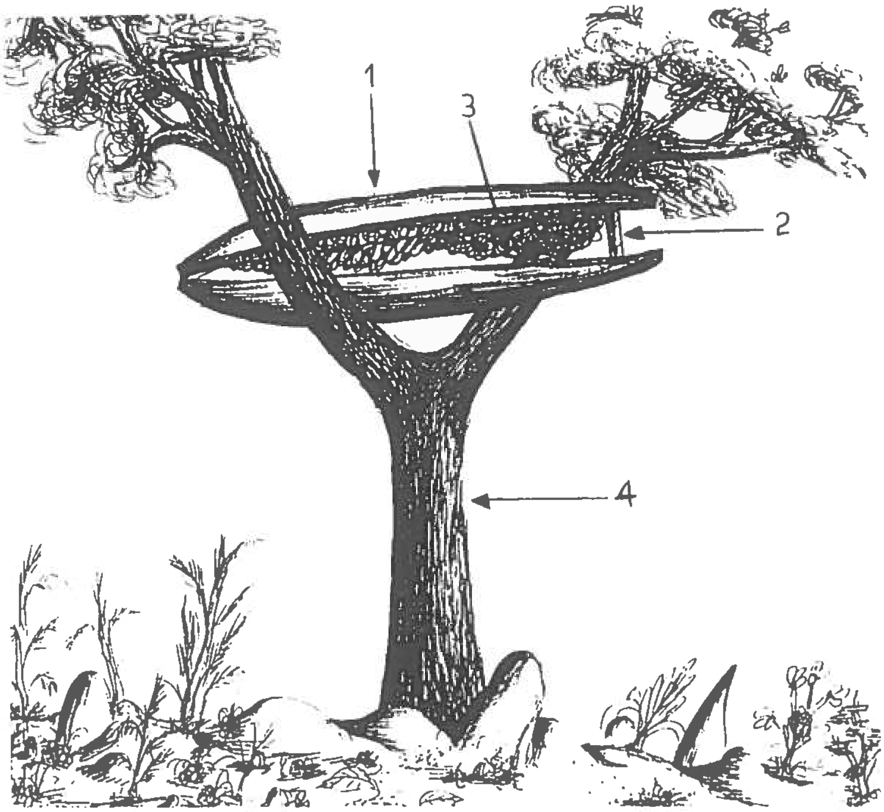

Figure 1: *Harvesting honey from Log Hive (Kihwele et al 1993a). 1= log hive; 2= wooden hinge to hold the top cover and expose the combs ready for harvesting; 3= exposed combs; 4= forked tree suitable for holding the hive in position*
Note: Sometimes the hive is placed on the ground for harvesting.

Honey containers

Figure 2: *Drums for storage (and transportation on a vehicle or cart) of honey.*

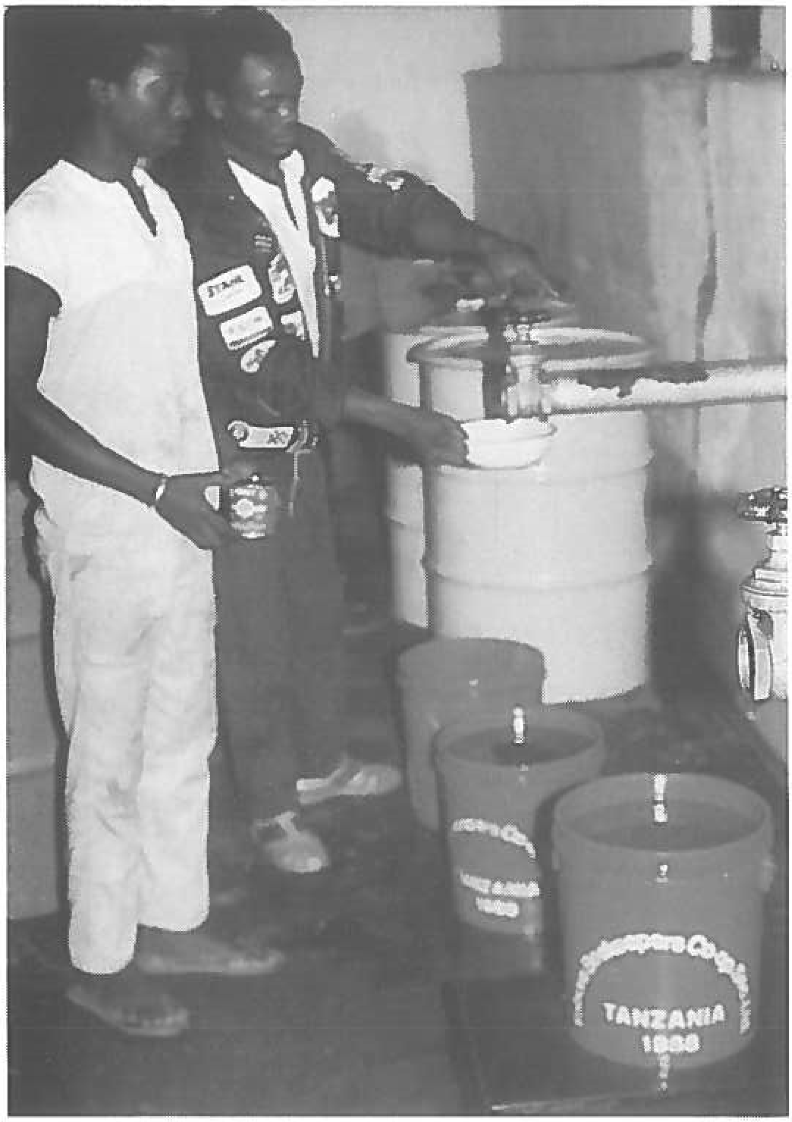

Figure 3: Plastic buckets for storage and transportation of honey.

Straining honey

Some beekeepers use heat of fire to facilitate easy straining of honey. Sometimes they over heat it, thus giving burnt smell of honey which leads to low price given to the beekeeper. Some beekeepers, in co-operation with beekeeping extension workers have developed better straining methods which are described below.

Use of two drums for straining honey

If the drums are made of steel, smear the inside with molten beeswax in order to avoid spoiling honey with rust. Stirring and skimming off beeswax particles from bottom drum follow after the straining is completed.

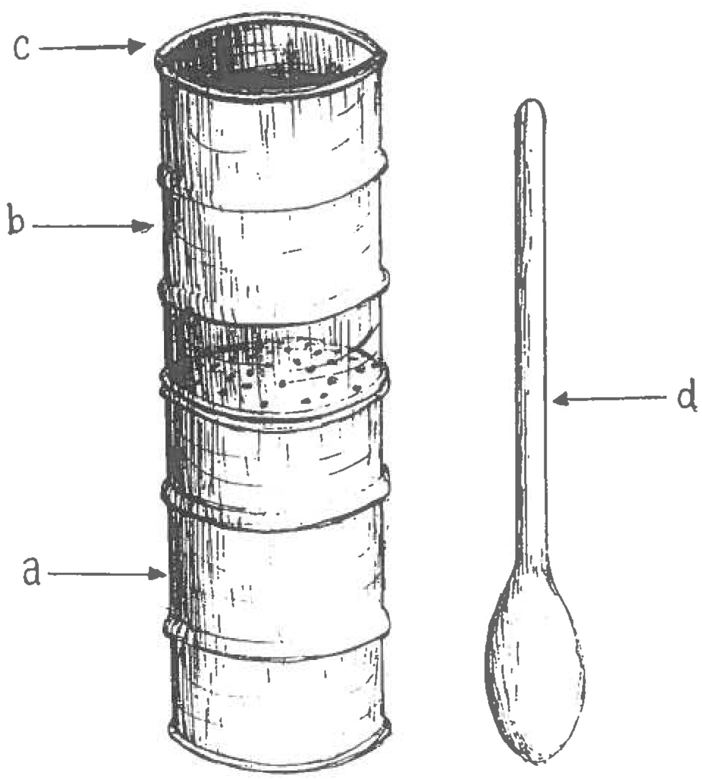

Figure 4: *Using two drums in straining Honey (Kihwele et al 1993a) a = Bottom Honey Drum. b = Top Honey Drum with a sieve at the bottom. c = Cloth covering honey to prevent dust and robber bees. d = Large wooden spoon (Mtela in Kihehe and Kipangwa) for crushing the honey combs and stirring the mixture.*

Using Bamboo Strainer

Stirring - settling - and skimming process is carried out in the honey drum after the straining is completed. The combs must be crushed in order to facilitate straining.

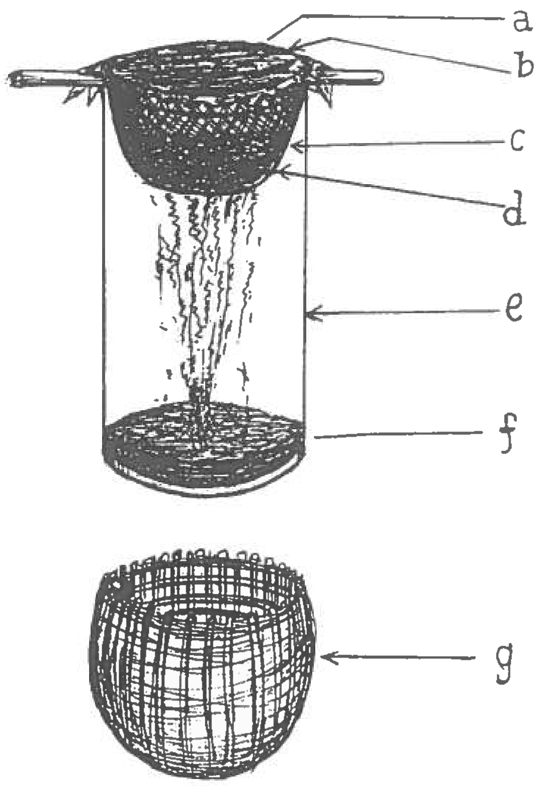

Figure 5: *Using Bamboo Strainer for the straining honey (Kihwele et al 1993a). a = stick holding the bamboo strainer; b = Cloth covering honey to prevent dust and robber bees; c = Honey combs in the bamboo stainer; d = Bamboo strainer; e = Honey Drum or Pail; f = Strained honey; g = Bamboo strainer (or "Tunduti" in Kipangwa).*

Simple stirring and skimming method

Some smallholder beekeepers use the Simple Stirring and Skimming Method for straining honey. This involves the following steps:

1) Put honey combs in a plastic pail;
2) Crush the combs with a stirring stick, cover it with a tight lid and let it settle for about 2 to 4 hours;
3) Skim off all the wax from the top, then stir it and let it settle again for 2 to 4 hours;

4) Skim off the floating wax and other impurities, and repeat activities in (b) and (c) until the honey becomes "clear liquid", then do the required bottling, packing and labelling for retail local marketing or for export markets. If the 300 kg drum is to be used for export, then its inside must be smeared with beeswax or special drums which are coated with lacquer material in the interior side are used, depending on the consumer supplier agreement.

Storing honey

Storing honey starts right at the beekeeper's camp in the *Miombo* woodland whereby the preferred vessels for storing honey are the 20-litre plastic pails, 300 kg - drums, gourds and clay pots as described in the section about honey containers.

The honey at both Beekeeper's Camp and home (in the village) is stored under a roof which is thatched with grass in order to avoid denaturing of honey by the heat of the sun.

Rendering beeswax

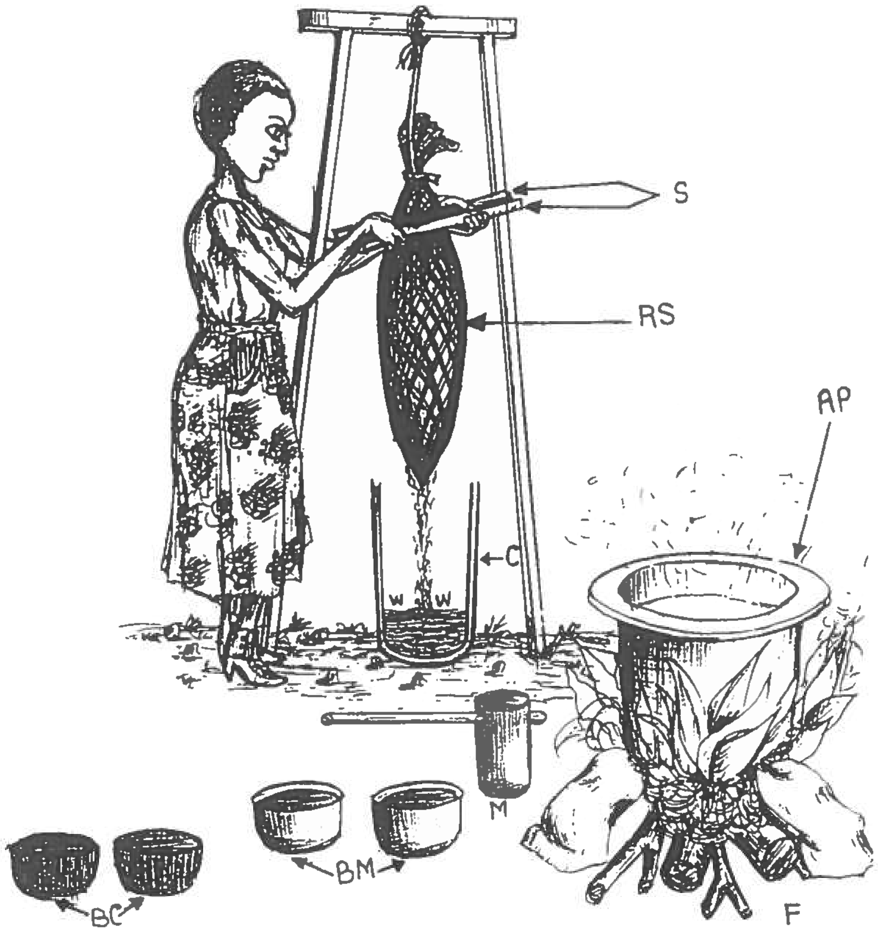

Figure 6: *Rendering Beeswax by "Tanganyika method" (Drawing from Kihwele et al 1993a; Kihwele 1991; Smith 1955;Ntenga 1977). S = Two wooden Sticks; RS= Rag strainer; WW= Water - Wax mixture; C= Wax container; AP = Aluminium Pot; BM= Beeswax mould (Enamel, Plastic or aluminium containers); BC= Beeswax Cakes ready for marketing; M= Kata (Riswahi Mnego (Kihehe Language), vessel used for fetching molten beeswax; a gourd with long "neck" is commonly used for this purpose in some areas.*

Traditional beekeeping in Tanzania encourages the production of both honey and beeswax. Honey straining, therefore, is accompanied by beeswax production. The following steps must be followed:

1) Soaking beeswax in equal volumes of water for at least 4 to 5 hours.
2) Heating the mixture in an aluminium pot to a boiling point with constant stirring; do not let the mixture to overboil.

3) Strain the mixture through a rag strainer into an enamel, aluminium or plastic container. Squeeze or press the strainer with sticks (Figure 6)
4) Let the water-wax mixture in the mould cool for two or three hours. Cover it to avoid dust.
5) Remove the beeswax cake and scrap off any dirt seen on the surface and especially at the bottom.
6) Break the cake into small pieces and mix them with clean water in equal volumes and heat the mixture in an aluminium pot, start with low heat with constant stirring. When all the wax has melted, the molten mixture can be strained through a cotton cloth into an enamel, aluminium or plastic container. Let the water-wax mixture cool down for at least two hours, then remove the wax cake ready for sale.

Constraints affecting honey quality control in Tanzania

Constraints at beekeeper level

The following are some of the constraints faced by the beekeeper:

1) Some beekeepers fail to get the appropriate containers for carrying and storing honey (see sections about honey containers and storing honey) due to either unavailability or prohibitive prices.
2) Beekeeper's poverty or occasional famine may force the beekeeper to harvest unripe honey which may easily ferment.

Constraints at extension worker level

1) The beekeeping extension worker fails to reach beekeepers due to lack of transport facilities.
2) Lack of extension workers in some districts makes it difficult to disseminate extension messages to beekeepers.

The use of radio and local news papers for dissemination of extension information is helping to alleviate the two problems.

Constraints at exporter level

1) Failure by some exporters to differentiate between lower and higher quality honeys in terms of setting prices discourages beekeepers who are keen in maintaining good quality honey.

2) Failure to meet consumer's preference in packaging Standards due to either unavailability of the appropriate packaging materials or lack of working capital which leads to using low quality containers which may adversely affect the quality.

Constraints at importer's level

1) Failure by some exporters to pay in time for received honey cripples the exporter financially hence creating a financial vicious circle which adversely affects the quality of honey exported.
2) Several exporters have complained that some of their clients do not pay for the honeys at all.

HONEY MARKETING IN TANZANIA

Honey marketing in Tanzania has been studied and reviewed (Kihwele l990b; 1991; 1985) as briefly accounted for in the following sections.

The local markets

Nature of Honey in the Market

Honey is sold as:

1) Comb honey
2) Pressed honey which is extracted by pressing bloodless combs with or without the application of moderate heat;
3) Crude or Semi-crude honey which is mixed with beeswax (crude) or part of beeswax removed and is in form of liquid (Semi-crude).
4) Strained Honey which is obtained by taking the Semi-crude honey from beekeepers and passing it through Strainers in the Tabora Beekeepers' Co-operative Society Honey Packing Plant. Tabora Honey with the label or logo "African Queen" is sold as "strained" honey, without visible dirt. Strained Honey of relatively similar quality which is produced by Straining - Settling Skimming and Stirring method (see section about straining honey) is commonly sold by Smallholder Beekeepers.

Demand and supply

The demand for honey is always greater than supply in both rural and urban areas. The production of honey is estimated to be less than 20 % of the existing honey production potential.

The main suppliers of honey are Beekeepers, Beekeepers' Co-operatives (Tabora Beekeepers Co-operative Society Ltd, TBCS and Kibondo Beekeepers Co-operative Society Ltd; Workers Beekeeping Economic Groups (WBEGs); Njiro Beekeeping Research Centre of P.O. Box 661, Arusha; individual traders and private companies. Recent surveys in Morogoro Region show that honey hunters also play a major role in supplying honey (Kihwele 1994).

Honey Market Segments and Consumer Preferences

There are three market segments for honey: the markets for :

1) Table honey
2) Beer honey
3) Medicine honey

Recent studies in Morogoro Region (Kihwele 1994); Tabora, Shinyanga, Arusha and Kilimanjaro Regions (Kihwele et al 1992); Iringa Region (Kihwele et al 1993a); Mtwara and Lindi Regions (Kihwele et al 1995) show that most of the honey goes into honey-beer (Wine, mead, etc. which are commonly known as Wanzuki) business.

Honey is also used for paying dowry, to pay for labour, etc. The Masai people, for example, use honey mainly for ritual ceremonies.

Honey prices

Currently the average prices are TSh 600/kg honey and TSh 1,500/kg beeswax.

The price for honey from stingless honeybees are about five times that for stinging honeybees due to its high medicinal values. Note: the current Exchange Rate is 1 US$ to TSh 600.

The international markets

Nature of Honey

With special beekeeping programmes, it is possible to meet different consumer preferences by producing monoflora honeys such as Sunflower Honey and Sisal Honey whose colours are pale-yellow and creamy white, respectively. Tanzanian strained honey is always sold as "Blended" Honey (blended by the bees themselves) or Polyflora Honey (mainly dark) from Miombo woodlands.

Demand and supply

Demand in the World market has always been greater than supply. In terms of overall World exports, Africa, including Tanzania makes an extremely small contribution of about 0.2 % of the 300,000 Tons World Honey Exports (ITC, 1986). Increased exports for Tanzania could be achieved provided quality and reliability are ensured.

Private Companies (See Appendix l) and Tabora Beekeepers Co-operative Society Ltd are responsible for the exportation of Tanzanian honey to countries such as Middle East which includes UAE, Kuwait, Saudi Arabia; UK;

Honey market segments and consumer preferences

Tanzanian honey is exported mainly for table and industrial uses.

Honey prices

Exporters of Tanzanian honey claim that they sell it at US$ 1,500 to 1,800 per Ton. There is no record about exports for honey from stingless honeybees.

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The writer expresses his sincere thanks to NECTAR and its Administration for inviting him to attend this very important Symposium, and, especially for their financial assistance which has enabled him to participate in the exchange of knowledge, experiences and ideas for the development of the Beekeeping Industry which will enhance socio-economic development for our countries.

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APPENDIX

List of exporters of honey and beeswax from Tanzania

Jami Export & Import Co. : p.o. box 382 USA River, Arusha
Tabora Beekepers Coop. Soc.: p.o. box 7017 ,Tabora
Tradep
Sea Dragon Enterprises
Agro Marketing (T) Ltd.: p.o. box 6649, Dar Es Salaam
Mohamed Enterprises (T) Ltd.: p.o. box 20650, Dar Es Salaam
Fida Hussein & Co. Ltd.: p.o. box 816, Dar Es Salaam
Mansukhalal & Co. Ltd. : p.o.box 32, Shinyanga
Tropex Ltd.: p.o. box 4850 , Dar Es Salaam
Waronga Co. Ltd.: p.o. box 3447, Dar Es Salaam
Derma International : p.o. Box 20161, Dar Es Salaam
Alphonce Ngailo
Abdi N. Farah: p.o. box 320, Tanga
Bongoyo General Supply: p.o. box 7408, Dar Es Salaam
Inter-Cargo Tanzania Ltd.: p.o. box 1510 , Dar Es Salaam
Aswan International: p.o. box 7712, Dar Es Salaam
E. R.. Investment Ltd.: p.o. box 597, Mtwara

Knowledge on the season for honey harvesting is essential for improved quality and quantity of hive products because it is not easy to assess the status of combs when using barrel hives. If the beekeeper harvested honey too early (i.e. a few weeks before the appropriate date), the following are some of the problems which would happen:

APICULTURE IN YUCATAN, MEXICO: PRODUCTION, MARKETING AND EXPORT.

C.M. Echazarreta

SUMMARY

Honey production in Yucatan has been, since the ancient Mayan times an important economical activity, through the exploitation of native stingless bees and trade of honey with other Indian groups.

Modern beekeeping industry with honey bees developed in the last 80 years, leading to a significant contribution in the world honey production from the 80's. In an area of 141523 km^2, a managed bee population of about 750 thousand of colonies yield 22 thousand tons of honey per year. Three factors contributed for the rapid success of the honey industry in Yucatan. First, the wild flora, with a large variety of plant species. Second, the introduction of gentle Italian bees together with modern equipment; and third, the establishment of co-operatives and honey plants of beekeepers that allowed the standardisation of large volumes of honey and control of price in the internal market.

In the last 10 years africanized bees, varroa, prices of honey and bee equipment and changing climate have strongly affected beekeeping in Yucatan. Economical unstability in the country and high interests on bank loans have recently worsten the scenario for the beekeepers. NAFTA has open markets, but reduced the support to production related actions.

THE RISE OF BEEKEEPING IN YUCATAN

Traditional Mayan beekeeping

Honey production in the Yucatan Peninsula is rooted far back in the times of the splendour of the Mayan civilisation. Various hieroglyphs in the ancient Mayan Codex Tro-Cortesianus have been interpreted as representing stingless bees and their products (Tozzer & Allen, 1910). In a section of this codex (examined by Bunge 1936, cited by Swartz, 1948), bee-like insects descending towards the figure of the evening star (Venus) are described. Hieroglyphs include 13 bees, one for each of the 13 months of 20 days that made up the annual cycle of Venus.

The book of "*Chilam Balam of Chumayel* " (a sacred text, named after their greatest Mayan prophet Balam, who lived in the 1400's) contains many references to bees, wax and honey (Roys, 1933). In the "*Popol Vuh* ", the sacred book of the Mayan-Quiche, it is related that the occupations of peoples of particular villages were the making pots and the keeping bees (Ransome, 1937).

Bishop Diego de Landa, who arrived in Yucatan in 1549, seven years after the Spanish conquest, wrote an extensive description of the life and customs of the Mayan Indians. He wrote "There are two kinds of bees and both are very much smaller than ours. The larger kind of these breeds in hives, which are very small. They do not make honeycomb as ours do, but a kind of small blisters like walnuts of wax all joined one to the other and full of honey. To cut them away they do nothing more than to open the hives and to break away these blisters with a small stick, and thus the honey runs out and they take the wax when they please. The rest breed in the woods in hollows of trees and of stones and there they search for the wax, in which and in honey this land abounds, and the honey is very good. These bees do not sting nor do they do harm when the honeycombs are cut out".

The larger bee, a bee that still is cultivated in log hives the same way at present times, is *Melipona beecheii.* The other, the small one, rather than one species is a group of species that the Mayan hunted for honey and wax.

Redfield and Villa (1912) described several species of honey producing Hymenoptera of Yucatan. They pointed out that these species are sometimes placed in hives and hung under the palmleaf eaves of houses, but they are not placed on the racks on which *Melipona beecheii* log hives are placed. Many of these honey producing Hymenoptera are probably stingless bees of the genus Trigona. The reference to *xik* by Redfield and Villa (1912) as small and black, and with the wings-just a little bit white, leads one to believe that *xik* is *Trigona (tetragona) nigra*. Other mayan bee names they supply are *kant-zac, bool, munl, ehol, xibi cab, colel cab* the nests of which are located in trees and some in the earth. The names of the bees, the instruments used in handling them and the knowledge of these bees persist little changed to the present (Gonzalez, 1984; Quezada and Gonzalez, 1994).

The extensive use of stingless bees that Mayans successfully managed across centuries allowed them to produce large amounts of honey that was traded with other Indian groups of Central Mexico and Central America (Calkins, 1973). Not only the indigenous population, but also the colonial Spaniards appreciated the bee products of Yucatan. Diego de Landa stated that during his stewardship as bishop of Yucatan towards the end of the sixteenth century each Indian was required to deliver a supply of wax as tribute, it was gathered in the forest from nests in logs, hollow trees and the clefts of rocks.

Introduction of European honey bee keeping.

Spaniards in the colonial times introduced European honeybees (*Apis mellifera*) in several regions of America, probably in the 1600's (Calkins, 1974). However, the successful honey and wax production from stingless bees prevented the introduction of foreign honey bees to Yucatan for some time.

Several factors probably led to the introduction of European honey bee colonies to Yucatan. One was the high yield of individual European honeybee colonies, a second was the influence of international market, with its standards for honeybee honeys. A third factor was a greater commercial interest for honey than for wax. This process of use of honey bees started in Yucatan with the onset of this century.

Three factors contributed to the rapid establishment and development of the honey industry with honeybees in Yucatan as we know it today. First was the wild flora, with a large variety of plant species and its abundance of nectar and pollen. Apparently, the land management that the Mayan indians practised in the jungle, involving slash and burn agriculture, allowed a gradual succession of plant species and contributed to the development of a assortment of nectar producing plants very suitable for beekeeping.

Blooming of *Viguiera dentata* Cav. (locally called tah) and *Gymnopodium floribundum* R. (locally called ts'its'ilché) from December to May provide the richest nectar flow in Yucatan, from which massive amounts of honey are harvested (Crane, 1975; Souza *et al.*, 1981). A wide variety of species sustain colonies during the rest of the year (Flores, 1991).

Second was the development through the breeding of gentle honey bees, was carried out simultaneously with the development and incorporation of modern beekeeping equipment such as Langstroth hives, movable frames, honey extractors (centrifuges), smokers, etc. In fact, Dadant equipment from the USA was available to the beekeepers in Yucatan, shipped from Florida. In the first introductions of honey bees into Yucatan that apparently occurred around 1911, German and Caucasian colonies that were previously established in the USA were then taken to Yucatan (Calkins, 1974). Shortly afterwards, Italian queens were imported from the USA as breeding stock (Gaumer, 1946).

After these importation's, extensive queen rearing was done to meet the demands of the growing beekeeping industry (Gaumer, 1946). The third factor facilitating the growth of a honey industry based on *A. mellifera* was the establishment of co-operatives and associations of beekeepers following the phase of entrepenurial development. With the support of the government, these associations built their own honey processing plants. This allowed the standardisation of large amounts of honey and contributed to the regulation of a standard price for the internal market.

The local land-owning elite fostered the industry and adapted the technology to local conditions during a protracted period of experimentation. Finally, with the advent of World War II, Yucatan's honey export market was opened through the efforts of a New York based trading company which was aggressively searching for honey to compensate the sugar shortages in the United States, (Merril-Sands, 1984).

The New York firm recognised the potential of the abundant floral resources of the Yucatan Peninsula as well as the good technical level of the existing small production base. In return for the exclusive right to market Yucatan honey, they helped to capitalise the industry sufficiently to support the establishment of several local honey exporting houses and a rapid expansion in production. The intervention of foreign capital in conjunction with the initiatives of local entrepreneurs established honey production as a major economic activity in Yucatan, which continued to flourish despite the eclipse of the unique and favourable economic conditions of the war era.

Development of beekeeping as an activity of peasant farmers.
The wealthy class in Yucatan controlled the production and marketing of honey until the late 1960s. However, then, the story took a fascinating turn in its development: the large-scale, capital intensive, apicultural enterprises of the elite gave way to a proliferation of small-scale, labour intensive, peasant operations. Today, commercial honey production is largely controlled by peasants. A similar transition occurred in the marketing sector; the ten private exporting houses were replaced by two government sponsored export co-operatives between 1968 and 1972. The co-operatives theoretically represented the interests of the estimated 8,000 peasant producers who now comprise 85 percent of the beekeepers in the State (Merril-Sands, 1984).

Commercial honey production was rapidly incorporated into peasant production systems through a natural process of technological diffusion. It was a response to: 1) declines in both the yields and the relative commercial value of corn, the staple food crop of peasant farmers, 2) the increasing integration of the peasant sector into the regional capitalist economy with the concomitant rise in the peasants' need for cash and desire for manufactured goods, and 3) the suitability of commercial beekeeping for peasant production systems.

Peasants learned the technology of beekeeping largely by working for the capitalist producers. They were subsequently able to capture production by circumscribing the large producers' access to floral resources and by substituting labour for capital. They asserted their legal right of control over the extensive *ejido* forest lands and forced large producers to remove their apiaries. In addition, peasant farmers' rapid propagation of small apiaries undermined the high yields on which the capitalist enterprises were dependent for profitability. Finally, in many parts of the State, peasants stopped working as wage labourers for the large producers and used their new knowledge of apiculture to produce honey independently. With the labour recruitment difficulties and the decline in yields, commercial apiculture lost its value as a remunerative capital investment, but simultaneously emerged as a high yielding form of production in the peasant sector, where the producer invests his own labour (Merril-Sands, 1984).

CURRENT SITUATION OF BEEKEEPING.

A regional perspective.

The 3 States of the Yucatan Peninsula, namely Campeche, Quintana Roo and Yucatan, have contributed between 30 to 40 % of the national production of honey over the past few years. Yet the Yucatan Peninsula represents only 8 % of the area of the country. From 1980, with the exception of few years (e.g.. 1985), the national production of honey has been around 60000 tonnes per year, whereas the peninsular production has been approximately 22000 tonnes per year.

The fluctuations of both the peninsular and national honey production have followed similar patterns and are probably due variation in precipitation. Rainfall has a high degree of variability and a strong influence on nectar production of wild flora and on colony survival. Yucatans' 5 month rainy season generally starts in June and ends in October.

The bee population of the Yucatan Peninsula in the last census (1993) was 778,996 colonies. The distribution of colonies within the 3 states of the Peninsula show some asymmetries. Campeche, the largest state, has a recorded 183,856 colonies. It contributes 24 % to the number of colonies, yet comprises 37 % of the area of the peninsula. Quintana Roo contributes 35 % of the area and 17 % of the number of colonies (135,000 colonies). Yucatan, the smallest state (24 % of land area) has the largest number of colonies (460,140), contributing 59 % of the peninsula's colonies.

The landscape and vegetation of the State of Yucatan has been strongly affected in the last 50 years by the use of land for extensive sisal (*Agave sisalana*) growing and livestock. Thirty four percent of the state is devoted to sisal plantations; extensive livestock (cattle, sheep, goats and pigs) in different parts of the state comprise 49 % of the total livestock of the Peninsula (Delfin *et al*, 1995).

Despite the strong competition for land and other resources with sisal and livestock, honey bee population and honey production in Yucatan is higher than those of Campeche and Quintana Roo. This suggests the latter two states still have considerable potential for further development of beekeeping. In fact, they have more land than Yucatan devoted to traditional agriculture and ecological reserves where beekeeping can be established.

As pointed out above, variation in rainfall is probably the major factor contributing to variation in honey production. In addition to the 5 month raining season, there are occasional heavy rains in January and sporadic light rains throughout the dry season (November to May). The timing and quantity of rain varies significantly from year to year.

The variation is not caused by changes in the number of days with rainfall, which actually remains constant at around 90 days from year to year, but in the intensity of the rainfall (Contreras, 1959). It is the highly irregular pattern of rainfall which if probably the greatest source of risk for apiculture.

Honey export

Over 90 % the honey produced in Yucatan is exported. This high proportion has remained rather constant since the mid 1970's. Yucatan supplies typically dark and aromatic honeys (such as the *ts'its'il che* or *Gymnopodium floribundum*), to the world market, most highly appreciated in Germany, Switzerland and the United Kingdom. Yucatan honey, and Mexico's in general, compete with China honey in the same market with light amber honeys, primarily in Germany and the United States. Competition from China seriously threatened Mexican exports in 1980-1982.

From 1972 to the mid 1980's, honey from the Yucatan Peninsula was exported through a government agency. This agency co-ordinated the sales from the three states, and it was established in order to present a united front to importers, and avoid detrimental price cutting which had developed over the previous years through competition between the three states. The agency was closed in the late 1980's due to political competition for the leadership of the agency. Nowadays, each state organises its exports. However, they normally keep a relatively standard price.

The standards of international quality control are maintained in order to remain successful in the world market. Particular attention is paid to moisture content (X< 20 %), Hydroxymenthy-furfuraldehyde (X< 40 ppm) and diastase content (X> 8ppm). Importers make contracts based on the quality of samples forwarded by the Yucatecan exporter. Samples are tested to ensure they meet standards, then the price is established for that particular load of honey. The subsequent shipment must conform to the sample. This procedure puts the exporters at a disadvantage because the importers always have a stronger arguments for bargaining.

Prices for honey vary considerably on the world market depending upon supply and demand, flavour, colour, aroma, floral source and tendency for cristalization (ITC, 1977).

All the honey exported from Yucatan is multiflora, coming from wild vegetation, mainly *tah* (*Viguiera dentata*) that crystallises quickly and is appreciated in the United Kingdom, and *ts'its'il che* or (*Gymnopodium floribundum*) producing a dark, liquid and very aromatic honey highly appreciated in Germany and Switzerland.

A particular advantage in relation to the honey trade in countries with unstable economies, like that of Mexico, is that as honey transactions are made in US dollars, devaluation of the local currency can generate high profits. However, this is a temporary situation which is balanced by inflation in the long term.

A profile of present-day beekeeping.
One of the outstanding issues for Yucatan beekeeping is that it is a sideline activity of poor farmers that complements their income from traditional slash and burn agriculture. This *milpa* agriculture for maize, beans and squashes provides a food supply, and honey production gives a cash crop (Merril-Sands, 1984). This mixed system is successful because it minimises risk by permitting the producer to maintain control over subsistence and by providing a degree of autonomy from the regional capitalist economy which the farmer can neither predict nor influence (Merril-Sands 1984).

Most of the 18 thousand beekeepers of the Yucatan Peninsula work under these conditions. Therefore the wealth generated by honey exports is distributed to many rural families. Two surveys undertaken in 1990 of 400 beekeepers in Yucatan, provide some interesting characteristics of the State's beekeeping. First, beekeepers are on average 48 years old and average 4 years of education in school (Berdugo *et al*, 1990). Most beekeepers (70 %) started the practice by purchasing colonies from other beekeepers, about 20 % started by receiving colonies as present from relatives and less than 10 % started receiving colonies from the government.

The majority learnt beekeeping from friends (50 %) and relatives (40 %), whereas less than 10 % of beekeepers learnt from government agencies. Most beekeepers have their own harvesting equipment (85 %), and use family hand labour (60 %) for honey harvest. Production of commodities other than honey is slight.

In general, beekeepers understand about colony inspection, promoting development of the brood nest, swarm prevention, predator control, feeding and harvesting. However, some of these techniques are not applied due to lack of resources such as wax foundation, empty hives, sugar and a vehicle.

New problems -Africanized honey bees and Varroa mites.
More recent problems for beekeepers in Yucatan are the spread of africanized honeybees present since 1987, and the spread of the mite *Varroa jacobsoni* from the beginning of 1995. The establishment of some regulations of the North American Free Trade Agreement may also create difficulties for Yucatecan beekeepers.

The undesirable behaviour of africanized honey bees, such as absconding and stinging, was a major set-back during the first 3 years after their arrival to Yucatan, when beekeepers had no protective clothing and no knowledge of how to handle them. The first swarms were highly defensive. A large extant european managed honey bee population has slowed down the process of africanization (Paxton *et al*, 1991). Government agencies predicted that within 5 years all of the honey bee population of Yucatan would be africanized. However detailed monitoring of the process has demonstrated that after 8 years less than 80 % of the colonies are africanized (Quezada *et al*, 1995). Another general prediction (Labougle and Zozaya, 1986) was that the honey production would drop by 70 % in Yucatan after 5 years of africanization. However, the fluctuations in honey production in the last 8 years have kept within the same range as before africanization.

Despite the fact that the overall effect of the africanized honey bees on honey production of Yucatan is of little significance, their effect upon individual beekeepers is strong. Some beekeepers abandoned their apiaries during the first 3 years of africanization, but new people took over beekeeping, which thus maintained a balance in the size of the managed honey bee population. In general, costs of beekeeping have increased because the need to use protective equipment, salaries for helpers, longer distances between apiaries, more feeding of colonies with sugar syrup and the need to requeen colonies.

The *varroa* mite was introduced to Mexico in 1993 and to Yucatan in 1995, through careless importation of queens from the USA. Although the mite is now found throughout the Peninsula, colonies are still at a very low level of infestation. Most beekeepers are concerned with the risk of contamination of honey if they were to use acaricides, and are willing to implement other forms of control, including the use of less harmful products.

Prospects for the future.
NAFTA is gradually establishing new conditions and regulations for trading. For the beekeepers in Yucatan it does not offer new markets because honey has for long been traded in the international market. However, as an agricultural activity, its government subsidies are gradually been withdrawn to a level of support experienced by all North American beekeepers. In return, Mexican beekeepers will have support to develop their marketing capability. This may be suitable for the large beekeeping companies in central Mexico, but it does not fit the requirements of Yucatecan peasant beekeepers, to whom transport of their honey, hives, sugar and other production-related supplies are the major constraints. Additionally, recent economic instability has led to increases in interests on bank loans on which beekeepers' associations rely for purchasing of honey from beekeepers.

Further development of beekeeping in Yucatan is expected to be based on increasing local honey consumption, and the ability of beekeepers to incorporate added value to honey and honey products. Development of the ability to produce selected honeys for the international and internal market, by assisting beekeepers to harvest from particular plant species, is another aspect that will improve beekeepers' situation. Finally, production of commodities other than honey, such as propolis, pollen and royal jelly and commercialisation of crop pollination could improve the intensity and profitability of beekeeping in Yucatan.

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PRODUCTION, PROCESSING AND QUALITY OF HONEYS IN CENTRAL AMERICA AND MEXICO

H.G. Arce Arce & J.W. van Veen

SUMMARY

Honey production in the Americas serves local consumption as well as export. 3.5 million hives are managed in Central America, Mexico and the Caribbean with an average honey yield of 24.7 kg/hive. Eighty percent of this production is from Mexico. Many Central American countries exported honey before the arrival of the Africanized bees, mainly to Europe. In Costa Rica, annual honey consumption per capita is about 350 g; ninety percent of the honey production is for family use.

In Central America most honey is produced by small beekeepers, e.g. in the Yucatan peninsula, more than 17,800 small Maya beekeepers produce about one third of Mexico's honey. In Costa Rica 85 % of the beekeepers practice beekeeping at small scale as a sideline activity. This contributes to the importance of local co-operations. The invasion of Africanized honeybees caused the disappearance of rustic beekeeping with fixed-comb hives and now most colonies are kept in Langstroth hives.

Migratory beekeeping is mainly applied for pollination purposes. In Costa Rica the africanized bees arrived in 1983, and four years later honey production had diminished and the import of honey started. The tropical region of Central America and Mexico offers a great diversity of melliferous plants and honeys normally are polyfloral. Local markets are poorly developed and just liquid honeys are sold. Locally honeys are sold expensive. Prices brutto per Kg. at these attractive local markets vary from 1 to 1.5 US$ in Mexico, Nicaragua, Guatemala and El Salvador up to 2 to 5 US$ in Honduras, Belize, Costa Rica and Panama.

INTRODUCTION

In the Americas honeybees (*Apis mellifera*) were introduced by the first European settlers. In precolumbian times beekeeping was practised widely with indigenous stingless bees (Meliponinae). For instance in Yucatan thousands of log-hives were kept by Maya Indians often in large "meliponarios", and the bees had a very special place in their religion (Crane, 1992; Weaver and Weaver, 1981). This traditional form of beekeeping with stingless bees is still widely spread throughout whole tropical America as an socio-economically important sideline activity for rural households (Arce et al., 1994; Crane, 1992).

Beekeeping with honeybees for the production of honey and wax became common because of the higher yields per hive in combination with improvement of hive management and technical development. Actually millions of hives are kept on the continent.

In 1956 an African race of honeybees (*A. m. scutellata*) was introduced into Brazil to improve the existing stock and adapt it to the humid tropical conditions of the Amazon region, where temperate zone honeybees produced little honey of poor quality. Since that period these African bees spread throughout the neotropics, cross-breeding with the European bees, forming a new multiracial hybrid, called "Africanized bees". These bees are very defensive and abscond easily, causing great problems for the small beekeepers. Honey production diminished and many beekeepers abandoned their hives (Spivak, 1991). Formerly honey exporting countries, like for instance Costa Rica, became dependent of imported honey to satisfy local consumption, just few years after local apiaries became "Africanized" (Van Veen & Arce, 1993).

Honey production in the Americas is important, both for local consumption and export. In Central America, Mexico and the Caribbean together an estimated 3.5 million hives are managed with an average honey yield of 24.7 kg/hive, which counts for about 9 % of the world honey production (Crane, 1990). Eighty percent of this production is from Mexico, making it one of worlds largest producers and exporters. Many Central American countries exported honey before the arrival of the Africanized bees, mainly to Europe, which implicates that tropical honeys of the region can meet export quality standards.

Very little information is available about honey quality in Central America. Usually light coloured liquid honeys are preferred to darker honeys, and efficient control mechanisms to detect contaminated, excessively heated, watery or adulterated honeys are lacking. In Costa Rica, annual honey consumption per capita is about 350 g. No special honeys are produced and all honeys have the same classification. Ninety percent of the honey production is for family use, only 10 % is used as raw material for the production of other products (Muñoz, 1988; Van Veen & Arce. 1993).

In this publication actual information is provided about honey production in Central America and Mexico, the way it is harvested and processed, some of its (botanical) characteristics and quality, the way it is commercialised and perspectives for future development.

BEEKEEPING IN CENTRAL AMERICA, INCLUDING MEXICO

An important characteristic of beekeeping in Central America is that most honey is produced by small beekeepers, with less than 20 hives. For instance in Yucatan, more than 17,800 Maya beekeepers, most of them are small farmers, produce about one third of Mexico's honey. In Costa Rica about 85 % of beekeepers have small apiaries and practice beekeeping as a sideline activity next to other agricultural businesses. A similar situation is found in Panama, Nicaragua, Guatemala, Honduras and Belize. In each of these countries just a few companies exist with more than 1000 hives. However in El Salvador 30 % of the hives (about 60,000) are owned by beekeepers who have more than 1000 hives.

In most countries of the region, beekeepers' associations, federations and co-operatives exist mainly for sharing processing and bottling facilities, and for the market of the honey and other hive products. Belize with only 136 beekeepers has 10 co-operatives. Mexico counts about 44 co-operatives and 123 associations. All other countries have between 1 and 5 co-operatives or associations.

After the apiaries became Africanized, the rural rustic way of beekeeping with fixed-comb hives almost completely disappeared. In Honduras for instance beekeepers had about 50 % of their colonies in such hives in 1982. Actually no rustic form of beekeeping is reported from this country, and neither from Nicaragua, Costa Rica and Panama. Nowadays rustic beekeeping can be found only in Mexico (8 %), Guatemala (5 %) and El Salvador (10 %). Most colonies in Central America are being kept in Mexico in Langstroth and Dadant hives (1,500,000) (Table 1).

Migratory beekeeping is not commonly practised. Most hives are transported for crop pollination purposes and usually not for honey production.

HONEY PRODUCTION IN CENTRAL AMERICA

According to Crane (1990), based on data of the years between 1982 and 1986, in Central America and Mexico, a total number of 3,743,000 hives produced 86,656 tons of honey (with Africanized bees already present in all of the countries, except Mexico). In Table 1 data are provided about numbers of beekeepers and the hiving method they use, total honey production and the actual average yield per hive, for each country.

It can be observed that the total honey production declined considerably (18 %) as well as the number of hives (25 %). This is mainly due to the impact of the africanized bees. For instance in Costa Rica the first africanized bees were seen in 1983. Four years after that observation, honey production had already diminished dramatically from 1000 mt to 675 mt, and the country started for the first time in its history import to honey to satisfy local consumption (Van Veen & Arce, 1993). Although the average yield per hive increased slightly during the last years (Crane 1990 mentions average yield per hive for Central America and Mexico of 23.2 kg) the number of hives and beekeepers became less. Only in Mexico and El Salvador, where the governments and beekeepers' associations support large scale requeening and training programs, the beekeeping level was maintained, or even improved (as in El Salvador). In all other Central American countries honey production diminished often with more than 50 %. Honduras had about 1000 beekeepers with more than 65,000 hives in 1982, actually just 26 beekeepers are left remained with 24,800 hives, of which 90 % are exclusively used for the pollination of crops.

Table 1. *Number of hives, hive type (D=Dadant, L=Langstroth), estimated number of beekeepers (N.D.= No Data), total honey production in 1994 and the average yield per hive.*

Country	Nffl of hives (1000s)	Hive type	Nffl beekeepers	Honey Production (tons)	Honey yield (kg/hive)
Mexico	2,500.0	D/L	45,683	62,852	25.6
Guatemala	60.5	L	3,000	3,636	34.0
Belize	3.7	L	136	60	29.6
El Salvador	190.0	L	N.D.	3,500	23.0
Honduras	24.8	L	26	58	20.0
Nicaragua	4.0	L	71	60	15.0
Costa Rica	25.0	L	900	625	25.0
Panama	4.5	L	137	138	35.0
Total	2,812.5		49,953	70,929	Mean 25.6

HONEY QUALITY

A few important factors influence quality and characterise honey in Central America and Mexico. On the one hand the most important nectar producing plants are typical for the region and influence flavour and chemical composition of the honeys. On the other hand hive management techniques and the way in which honey is harvested and processed, influence purity and quality of honey. In the following paragraphs data on these themes are discussed.

Botanical origin

Central America and a large part of Mexico are tropical and have a great diversity of melliferous plants (Ordetx, 1952). This means that honeys normally contain pollen of many plant species, indicating their polyfloral origin. But few special honeys are obtained from monofloral nectar sources, like *Coffea arabica* in Costa Rica.

Table 2. *Important nectar providing plants, as mentioned by beekeeping experts for different countries in Central America and Mexico. C.R.=Costa Rica; Pan=Panama; Nic=Nicaragua; Hond= Honduras; Guat=Guatamala; El. Sal.=El Salvador; Bel =Belize and Mex =Mexico.*

	C.R.	Pan.	Nic.	Hond.	Guat.	El. Sal.	Bel.	Mex.
Agave spp.								x
Anacardium spp.	x	x	x				x	
Antigonum leptopus	x					x		x
Avicennia germinans			x				x	
Baltimora recta			x	x				
Bidens pilosa								
Bursera simaruba	x	x			x			x
Byrsonima crassifolia	x						x	
Calycophyllum candidissimun	x	x						
Cassia grandis	x			x		x	x	
Citrus spp.	x		x	x				x
Coccoloba caracasana	x						x	
Cocus nucifera	x		x					x
Coffea arabica	x		x	x	x			
Combretum farinosum								
Cordia alliodora	x	x				x		
Gliricidia sepium	x		x	x	x	x		
Gymnopodium antigonoides								x
Hyptis suaveolens								
Inga spp.	x	x	x	x	x			
Ipomoea spp.	x		x	x	x			x
Lonchocarpus spp.	x		x		x			x
Lysiloma divaricatum								x
Mangifera indica	x		x					x
Pithecolobium saman	x				x	x		x
Sida rhombifolia								
Tabebuia spp.	x	x	x	x	x	x	x	x
Tamarindus indica	x						x	
Trichilia havanensis				x	x			x
Vernonia spp.					x			

Table 2 shows 30 of the most important nectar producing plants in Central America and Mexico, as mentioned by local beekeeping experts (see acknowledgements). The list is not complete, and plants mentioned in the list but not marked for a country does not mean that they do not occur or are not important in that country. As we can see most of them are wild plants and only relatively few cultivated plants are important (coffee, citrus and mango).

Most of these species have been mentioned by Arce et al. (1994), Crane (1990), Mendoza (1991), Ordetx (1952), and Silveira (1990). Some of the above mentioned species may locally be so abundant that their nectar may characterise honey flavour and colour, as for instance *Avicennia, Citrus, Coffea arabica, Cordia alliodora* and *Gymnopodium antigonoides* (which is Yucatan's most important nectar plant [Ordetx, 1952]). However, only few beekeepers produce and market these special monofloral honeys.

Honey harvest: extraction, processing and packing
In the process of harvesting the honey several factors influence the quality of the honey.
As known, honey should be harvested from combs containing only capped honey, without brood (Arce & Van Veen, 1993; Crane, 1990; White, 1992). However Africanized bees tend to ripen (and store) less honey than European *A. mellifera*, because of a high turnover of honey into bees (Fletcher, 1991). This commonly results in honey harvested from only partially capped combs, which in its turn results in honey with a high water content. Honeys sold in Costa Rica (n=10) or presented at honey shows (n=64) seldom have a water content less than 18.5 %, averaging respectively 18.7 and 19.3 %. It is very important however to note that these honeys do not ferment easily!

Because of the strong defensive character of Africanized bees, occasionally excessive smoke is applied to the hives, when the honey is harvested. This gives an unpleasant flavour to the honey. In Mexico and Guatemala BeeGo® and benzaldehyde are used frequently to drive bees out of honey supers as an alternative for smoking.

Honey is usually extracted with locally made tangential two, three or four frame hand extractors, often at night in the open air near the apiary, or in a shed near the beekeeper's house. Six or more frame stainless steel extractors of reputable make are commonly used by larger beekeepers. Some beekeepers strain the honey immediately after extraction, more commonly honey is stored in barrels (content of 55 gallon) or bottles without filtering. No heating to facilitate the extraction of the honey from the combs, or before storage to avoid its crystallisation, is practised. After a few days when most wax particles and impurities float on the surface of the honey, it is either passed to another barrel or bottled. Shortby before being bottled the honey is heated to prevent crystallisation. For this purpose three techniques are being used commonly: first of all submergence of a barrel with honey in a hot water reservoir for a long period (varying from 8 hours to more than 24 hours, temperatures often exceeding 60°C), secondly direct heating of a barrel above a fire, and thirdly placing the barrel outside in the sun, the last two methods without any temperature control at all. A small survey of Costarican honeys sold at supermarkets and drugstores revealed that 8 out of 10 samples tested had very high hydroxymethylfurfural (HMF) levels (measure for honey being heated in excess).

A fifth factor influencing honey quality in Central America and Mexico is the kind of jars and bottles used. Most honey is marketed in second-hand clear glass (liquor) bottles (0.7l, 0.35l or 0.2l). Occasionally honey is sold per gallon (plastic mineral water bottles) in El Salvador and Belize. Glass jars of different size with contents of less than 500 ml are commonly used in Costa Rica and Mexico. However all these jars and bottles have in common the fact that they are second hand and that remainders of former contents may contaminate the honey. Often even the lids, corks and tops are not new and do not always fit properly. Usually for transparent glass or plastic packing is chosen so that the consumer can see the content, which preferably should be as light as possible, liquid and without crystals.

Quality control

In all countries exists quality control for imported and exported honey and for honey traded at the national market. The aspects taken into consideration and the frequency at which controls are carried out varies greatly between the countries. Imported honeys are usually only controlled on water content, visible and bacterial contamination and sometimes on excessive heating (HMF) by the Ministry of Agriculture. The buyer usually controls flavour and colour additionally to the above mentioned. Only for El Salvador control on pesticides and diastase was mentioned. Exported honey is controlled on water content, density and excessive heating only. It's obvious that the policy is that the buyer controls quality. The quality of honey at the national market is controlled by the Health Ministry. In all countries yearly samples of the honey have to be presented for renewal of licenses. These samples are only checked on taste, water content, density, visible and bacterial contamination and the information provided on the label, in all countries, and only occasionally randomly tested, sometimes including adulteration and excessive heating. No pesticide controls are practised.

MARKETING OF HONEY IN CENTRAL AMERICA AND MEXICO

As may be understood from the above mentioned, local markets in Central America and Mexico, although honey consumption is quite high, are poorly developed. Only liquid honeys are sold, preferably with a light colour and absolutely without crystals. Crystallising honey is considered as adulterated. Presentations of organic honey, creamed honey or comb honey is exceptional in all countries. Monofloral honeys which can be harvested in most countries from coffee or citrus (see Table 2), are not sold as such, and only in Yucatan honey from *Gymnopodium antigonoides* is known and sold as a special product. Studies however show that perspectives are quite good for these special honeys (Arce & Van Veen, 1993).

Locally honeys are sold at a high price, which makes national markets attractive, especially if we keep in mind that labour, transport, and equipment is relatively expensive in Central America, making it difficult to compete with large-scale beekeeping organisations in other parts of the world. Prices at the local market vary from 1 to 1.5 US$ minimum in Mexico, Nicaragua, Guatemala and El Salvador up to 2 to 5 US$ in Honduras, Belize, Costa Rica and Panama.

Honey is sold through distributive trade (wholesale) by larger beekeepers or in bulk to honey packers. Small-scale beekeepers practice retail sale, normally in their vicinity.

Large firms and co-operatives, especially those in Mexico, El Salvador, Belize and Guatemala export most of the honey they produce.

In order to satisfy local markets Panama and Costa Rica import honey, mainly from El Salvador, Guatemala and Mexico. All other countries have a positive export balance, while Germany and the USA are the biggest importers.

In Table 3 data are presented about honey export and import over 1994 for countries of the region.

Table 3: *Honey export and import (1994) in metric tons (mt), N.D.= no data.*

Country	Honey export (mt)	Honey import (mt)
Mexico	45,000	-
Guatemala	1,820	-
Belize	60	-
El Salvador	2,100	234
Honduras	-	-
Nicaragua	100	-
Panama	-	N.D.
Costa Rica	-	350

STINGLESS BEE HONEYS

As mentioned in the introduction in Central America and Mexico beekeeping with stingless bees is still quite common. It is characterised by its small scale, and traditional way of being practised/ colony management, without advanced equipment or modern hives. The honey these bees produce is very different of that of *A. mellifera*, and is hardly known outside of the tropics. Because of the medicinal properties ascribed to it, it is generally spoken preferred by the local people (Arce et al., 1994a,b). It has therefore a several times higher market value. Although the production is much lower than of *A. mellifera*, production costs are also low (no protective equipment or expensive hives required) and hives can be kept under the roofing of the beekeepers house (Arce et al., 1994a,b; Crane, 1992; Weaver & Weaver, 1981).

Problem for developing a (international) market for stingless bee honey is that the keepers of these stingless bees are not organised in associations or co-operatives, which implies that its promotion and production on a large scale is very difficult.

PERSPECTIVES

Perspectives for the production of good quality honeys in Central America are quite positive. First of all the local market can be more developed. It is clear that the average honey consumption per capita is high, although the product is expensive. Whereas in other parts of the world even more honey is consumed in crystallised form than in liquid state (Crane, 1990), in Central America and Mexico creamed honey is hardly ever eaten. Also the production of comb honey has good perspectives (Arce & Van Veen, 1993). Educational publicity for these products might improve their acceptation and consumption.

Honey quality can be improved considerably if more care is taken when honey is heated either to prevent crystallisation to liquefy crystallised honey again. Clean extraction facilities where honey is strained through good filters will make honey pure and brilliant. Such expensive facilities can be obtained by associations or co-operatives, and their use shared between the members.

Clean and new uniform bottles and jars with new lids and attractive labels will improve sales and not spoil the quality (flavour) of the honey. Accurate and intensified quality control through independent institutes or Health Ministry will force beekeepers and honey packers to improve their management techniques.

Research on the chemical composition and properties of tropical honeys might reveal new characteristics of it. Why for instance do stingless bee honeys not ferment although they may contain over

30 % of water? Africanized bee honeys also contain often more than 18 % of water and do not ferment rapidly. If international honey standard regulations would be adapted to characteristics of tropical honeys, these valuable products would have better perspectives for export to other continents.

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COMPOSITION AND QUALITY CONTROL

QUALITY CONTROL OF HONEY AND OTHER HONEY BEE PRODUCTS IN VIETNAM

Huynh Kim Tuyet

SUMMARY

Apiprodex Saigon has been established in 1987. In cooperation with the Committee for Science and Technology Vietnam (KWT) and the Vietnamese beekeepers, quality control of honey has continuously improved. Since 1987, the export of honey by Apiprodex Saigon increased from 165 to 920 mt. The properties of coffee, hevea, rambutan and longan honey are given. Control methods are briefly mentioned.

The control of honey and other honeybee products under our conditions causes problems because of lack of information, chemicals and equipment.

Future plans include:

- Cooperation with other organizations.
- Improvement of knowledge of quality control and processing of bee products according to international standards.
- Further national and international cooperation concerning pollen identification, crystallization of decenoic acid in royal jelly, HMF-content and diastase activity.
- To make a survey of different kinds of honey from *Apis mellifera*, *Apis cerana* and *Apis dorsata* harvested in southern Vietnam.
- Study of the effect of storage on honeys.

However, in order to carry out the plans mentioned above, financial support has to be obtained.

INTRODUCTION

Apiprodex Saigon, under the competency of Vietnam Apiculture, and belonging to the Ministry of Agriculture and Food Industry, has officially been established in 1987. Apiprodex Saigon is specialized in export of honey bee products and the supply of materials and equipment for beekeepers in Southern Vietnam.Every year, hundreds of beekeepers deliver their products to our company. These products are controlled, sorted and refined by modern processing units for export and the local market.

From 1988 the laboratory of Apiprodex has controlled the quality of honey to reach the FAO and EC standards. Due to the support of KWT (Committee Science and Technology Vietnam, The Netherlands) and the investment policy of our company, the beekeepers were strongly stimulated and both quality and quantity of our products constantly improved. For instance, before 1988 the water content of honey still ranged from 22 to 24 %, the amount of reducing sugars was less than 65 %, and the export price was only US$ 500 per ton FOB Ho Chi Minh. At present the quality of honey is becoming increasing (see Table 1) and the export price is US$ 780 per ton FOB and more.

Due to the confidence of our customers in the high quality and to the competitive prices, the amount of our products not only increased in the local market but also reached the world market.

Table 1: *Export of Apis mellifera products by Apiprodex Saigon.*

Year	Honey *	Pollen **	R.J. **	Countries
1987	165			France
1988	285			France, UK
1989	345	900		The Netherlands, Japan
1990	434			Japan
1991	474		10	Japan, France
1992	518		351	Japan, France
1993	655		564	Japan, Malaysia
1994	774		162	Japan, UK, USA
1995	920	1000		Germany, UK, Indonesia, USA

R.J.= Royal Jelly; *= metric ton; **= kg

SURVEY OF HONEY

Capacity: 2300 - 2600 tons per year.
Main production areas: Dong nai, Lam dong, Tien giang, Dac lac, Long khanh and Gia lai province.
Kinds of honey:

- Hevea: Extra floral from the pararubber, *Hevea brasiliensis*, harvested from February to May.
- Coffee: Blossom honey from the coffee tree, *Coffea arabica*, harvested from January to May.
- Rambutan: Blossom honey from the fruit tree, *Nephelium lappaceum*, harvested from March to May.
- Longan honey: Blossom honey from the fruit tree, *Euphorbia longana*, harvested from May to June.

  Number of analyzed honey samples: At least 200 samples per year.

METHODS OF ANALYSIS

Colour: Honey is graded for colour according to the Pfund colorimeter (by the Lovibond scale 2000).

Water content is determined by using an Atago hand honey refractometer.

Acidity is determined by titration against a carbonate-free alkaline solution using a neutralized phenolphthalein indicator. The end-point colour should persist for 10 seconds. The result is expressed as milliequivalent acid per 1000 g of honey.

Reducing sugar content is determined according to the Bertrand method [3]. Reducing sugars in honey react with a Fehling's solution to produce cuprous oxide, then the cuprous oxide is filtrated by vacuum filtration and dissolved in a known quantity of acid ferric sulfate solution (5 % ferric sulfate and 20 % sulfuric acid). The reduced iron is titrated with 0.1 N potassium permanganate solution and the corresponding amount of reducing sugar is found in the table of Bertrand.

Sucrose content [2] is determined by the Bertrand method before and after inversion. The amount of sucrose is calculated by the difference; 6.34 N hydrochloric acid is added to the honey solution, the mixture is heated at 65° C. during 5 minutes. This solution is allowed to cool for 15 minutes and brought to 20° C. and neutralized with 5.0 N sodium hydroxide using phenolphthalein as indicator, the reducing sugar content is determined by the Bertrand method.

Glucose and fructose content [1,2]. Glucose is estimated iodometrically, total reducing sugars by the Bertrand method and the amount of fructose is obtained by the difference. Pipette a volume of 0.1 N iodine at least twice for the reaction into honey solution, then add 0.2 N sodium bicarbonate/carbonate solution, leave in the dark for 2 hours, acidify with 25 % sulfuric acid and titrate with 0.1 N thiosulphate solution. Carry out a blank at the same time. The difference between the two titrations represents the glucose content. Fructose = total reducing sugars - glucose.

Spectrophotometric determination of HMF [4]. HMF (5-hydroxymethyl furfural) has an UV absorption maximum at 284 nm. By adding sulphite an alpha, beta-unsaturated carbonyl system is formed, through which the absorption maximum disappears. The difference in absorption is a measure for the amount of HMF. 10 % honey solution is cleared by 0.5 ml of 15 % potassium ferro-cyanide and 0.5 ml of 30 % zinc-acetate solution and filtrated through a paper filter.

- Sample solution: pipette 5 ml of filtrate, add 5 ml of water and mix well.
- Reference solution: Pipette 5 ml of filtrate, add 5 ml of 0.2 % natrium bisulphite solution and mix well.

Determine the absorption of the sample against the reference at 284 nm and 336 nm.

Diastase [2,5]. The rate of starch destruction is determined by the intensity of the iodine blue colour read at 660 nm.

- Determination of blue value of starch: Pipette 5 ml of a 2 % starch solution, add 10 ml of water at 40° C. and mix well. Then, pipette 0.5 ml of this solution in a conical flask containing 5 ml 0.0007 N iodine solution, add about 20 ml of water and mix well. Read the colour at 660 nm against a water blank. The absorption should be 0.760 ± 0.020. If necessary the volume of added water is adjusted to obtain the correct absorbance. Note the amount of ml water.
- Honey solution: Weigh accurately 5 g of honey with 10 ml of water and add 2.5 ml acetate buffer pH 5.3 into a 50 ml beaker, stir until dissolved, add 1.5 ml 0.5 M sodium chloride solution to a 25 volumetric flask and transfer the dissolved honey sample to this and adjust the volume to 25 ml.

Pipette 10 ml honey solution into 50 cylinder and place in 40° C. water bath with flask containing starch solution. After 15 minutes, pipette 5 ml of starch solution into the honey solution, mix and start stop-watch at 15 min, remove 0.5 ml aliquots and add to 5 ml 0.0007N iodine solution, mix and dilute to known volume of water. Read at 660 nm. Continue taking aliquots at intervals until absorbance of less than 0.45 is reached.
Diastase activity is ml starch solution 1 percent hydrolyzed by the enzyme in 1 g of honey in 1 hour at 40° C.

HMF and diastase content are analyzed at the Laboratory of the Polytechnic University of Ho Chi Minh city [4,2,5].

RESULTS

Honey

The average results of the analysis of mellifera honey samples carried out at our laboratory from 1989 to present have been summarized in Table 2.

Table 2. *Quality specifications of main kinds of honey from A. mellifera in Southern Vietnam (Source: Tuyet, 1995)*

Specification	Coffee	Hevea	Rambutan	Longan
Colour	LA-A	ELA-LA	ELA-LA	ELA-LA
Water content %	19.2-20.5	20.0-21.5	20.8-22.2	22.5-23.8
Acidity meq/kg	20.8-35.7	18.4-23.5	21.2-28.6	21.2-25.4
Reducing sugar %	72.4-74.6	71.4-72.8	70.2-72.1	67.8-70.1
Sucrose %	1.2 -2.8	0.9- 2.1	0.7- 1.8	0.7- 1.6
Glucose %*	36.7-38.4	36.7-37.8	35.8-36.8	34.6-35.4
Fructose %*	35.7-36.2	33.8-34.8	34.4-35.3	33.3-34.7
HMF mg/kg	3.5- 6.8	1.2- 4.4	0.5- 2.1	0.4- 0.9
Diastase (Gothe)*	8.9- 9.4	9.2-11.8	10.9-12.6	.8-11.8

A = amber, LA = light amber, ELA = extra light amber

* We analyzed these samples according to the customers' requirements.

The average results of analysis of *cerana*, *dorsata* and *florea* honey samples (Table 3) have been obtained by Cuong P. V. et al. (1993-1995) [6].

Table 3. *Average results of analysis of honey samples from Apis cerana, Apis dorsata and Apis florea.*

Apis species	*A. cerana*			*A. dorsata*	*A. florea*
Specification	Eucalyptus	Longan	Jujuba		
Water content %	27.0	24.0	23.5	28.0	32.2
Reducing sugar %	66.7	70.7	69.9	66.3	60.1
Sucrose %	4.5	2.5	3.3	4.1	7.2
Glucose %				43.5	44.4
Fructose %				22.8	15.6
Acidity meq/kg	25.0	17.7	17.2	58.0	70.0
HMF mg/kg	2.8	3.5	10.2		

Dorsata and florea honey samples have been analyzed 4 months after harvesting.

We check honey quality for all beekeepers' and other organizations who deliver their products to our company. Honey, exported to other countries as well as sold in Vietnam, has been analyzed comparing it to FAO and EC standards, however, water content of honey for the local market is higher (from 22 to 24 %). From 1989, honey is not heated in the processing unit to maintain the natural characteristics, therefore, HMF content is low and diastase content is high (see Table 2).

Royal jelly

Capacity: 1000 - 1200 kg per year.

Harvesting period: From July to February next year according to the needs of consumers.

Quality:

- Water content % (by loss of drying at 60 - 70° C. under low pressure and mixed with 7 g dried sea sand)	- 65.02 - 67.00
- Total Nitrogen % (Kjeldahl method)	- 1.60 - 1.90
- Reducing sugars (iodometry method)	- 14.0 - 16.8
- 10-Hydroxy-2-decenoic acid content (by high pressure liquid chromatography)	- 2.35 - 2.65
- pH	- 3.9 - 4.2

Royal jelly is analyzed at the laboratory of the Centre of analytical and experimental Service in Ho Chi Minh City

Pollen

Capacity: 9,000 - 11,000 kg per year.

Harvesting period: From August to December.

Kinds of pollen: Tea pollen come mainly from tea flowers, coffee pollen come mainly from *Coffea* flowers. The colour of melange pollen varies from white to yellow, orange, red.

Quality of pollen:

- Water content % (loss of drying)	- 10.2 - 12.9
- Total nitrogen % (Kjeldahl method)	- 2.2 - 2.5
- Ash content %	- 1.9 - 2.3
- pH	- 3.8 - 4.1

Pollen is mainly analyzed at the Pasteur Institute Laboratory of Ho Chi Minh City.

DIFFICULTIES IN HONEY QUALITY CONTROL

We have had problems in analyzing honey and other honeybee products due to:

- lack of information on methods of analysis suitable for our conditions
- lack of chemicals (pure analysis) and equipment

- working conditions at laboratory are not sufficient for accurate analysis
- difficulties to obtain and store some chemicals, e.g. sodium bisulphite, for determination of HMF, is easily oxidized
- analysis method of glucose and fructose is not yet stable in spite of continuous study

FUTURE PLANS

We would like to cooperate with other organizations and individuals:

- to improve our knowledge of quality control and processing of bee products
- to study methods of analysis e.g. the identification of the origin of honey by means of pollen determination and the observation of the crystallization of decenoic acid in royal jelly
- to be trained further as an inspector of bee products to study other valuable characteristics of the bee products in order to improve the export price
- to receive support for procuring chemicals and equipment to upgrade our analytical laboratory
- to make a survey of different kinds of honey from *Apis mellifera*, *Apis cerana* and *Apis dorsata* occuring in southern Vietnam and to study the effect of storage on honey quality

We hope to establish relations with organizations in the future and strongly believe that such a cooperation will be mutually beneficial and will positively contribute to develop the Vietnamese beekeeping industry.

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LABORATORY EXPERIENCE IN NEPAL: HONEY ANALYSIS AND HONEY COMPOSITION

Mahalaxmi Shrestha

SUMMARY

About 300 samples of *Apis cerana* honey were analyzed in the Beekeeping Research laboratory, Kathmandu, Nepal. In general there is a good compliance with Codex regulations, however for honeys from *A. cerana,* the reducing sugar contents are sometimes below (mimimum reducing sugar content found 58.1%) and sucrose contents are in some cases above (maximum sucrose content found 13 %) the EC norms.

Secondly there is a marked difference in enzyme activity between *A. cerana* and *A. mellifera* honey: glucose oxidase as well as the diastaseindex were lower for cerana honeys. pH was found to be slightly higher for cerana honeys (range 4.17 to 5.50), when compared to *A. mellifera* honey.

After starting the quality analysis of honey in Nepal, honey quality has gradually improved, although in the local markets adulterated and heated honey may still be found.

INTRODUCTION

The tradition of beekeeping and harvesting honey in Nepal dates back many years. Honey has traditionally been harvested from different species of bees, e.g. *A. cerana, A. dorsata* and *A. laboriosa* . Beekeeping is considered an integral part of farming and bees are kept in log hives and wall hives in most parts of the country.

The on farm produced honey is generally of good quality with characteristic floral composition. As there is no quality legislation for honey in Nepal, some traders have been able to sell adulterated honey in the market. Thus formulation of a quality standard for honey as well as effective implementation is necessary for further development of the honey market.

The Beekeeping Research Laboratory belongs to a non governmental and non profit organization and conducts research and quality control of honey, the last in close cooperation with Mr. J. Kerkvliet, following the five step program (described by him in these proceedings). The laboratory receives honey samples from different parts of the country and provides quality analysis free of charge. If the honey is of good quality the Beekeeping Shop, which belongs to the same organization, sells the honey.

The Beekeeping Research Laboratory also carries out research on physico-chemical properties and on botanical origin of honey from different regions of Nepal. For this purpose honey is being collected directly from hives during field visits. The International Foundation of Science, Sweden provides a research grant for this project.

FIVE STEP PROGRAM OF ANALYSIS

1 Water content:	- By hand refractometer
2 Reducing sugars and apparent sucrose:	- Titration method, Lane et al. (1923)
3 HMF:	- Extraction with ethylacetate and colour measurement with resorcinol, White et al.(1988).

Honey is dissolved in water and extracted with ethylacetate. Part of this extract is added to a resorcinol/hydrochloric acid solution. HMF gives a pink colour which can be measured in a photometer.

A calibration graph for the used photometer should be made, using honey samples with known HMF contents, e.g. analysed in a laboratory where the standard HMF procedure is carried out.

4 Microscopic analysis: - Microscopic detection of adulteration of honey with cane sugar and cane sugar products: Kerkvliet et al. (1995)
- Pollenanalysis according to Louveaux et al. (1978)

5 Peroxide accumulation (glucose oxidase):
- Screening methode with peroxide test strips, Kerkvliet (1994)

In addition to these five tests, the following tests are also carried out:

Diastase:	- Anonymous (1989)
pH and electrical conductivity:	- Measurement in 20% (m/m) solution.

RESULTS

Based on the results obtained by analysing about 300 *A. cerana* honey samples from different regions of Nepal by following the above procedures, the quality of *A. cerana* honey can be summarized as below.

Water content

Water content was found to be in the range of 17 to 21 % with an average value of 18.57 %. Generally water content did not show a large variation except one sample containing 24 %.

Reducing sugar and sucrose

The maximum and minimum reducing sugar contents recorded were 74.18 % and 58.10 % respectively. Though most of the samples contained more than 65 % reducing sugar, 13 out of 109 samples contained less than 65 % of reducing sugar.

HMF

Most honeys contain less than 40 mg/kg HMF. Only heated and adulterated honey contained more than 40 mg/kg HMF. So HMF content is not a quality problem in cerana honey from Nepal.
Table 1 shows the results of a semi-quantitative analysis of 141 honey samples.

Table 1: *HMF content of honey samples.*

HMF content in mg/kg	No. of samples
Less than 10	109
Between 10 and 20	24
Between 20 and 30	6
Between 30 and 40	1
Between 40 and 50	1

Microscopic analysis

Microscopic detection for sugar cane particles has been very useful and efficient to detect adulteration of honey with cane sugar and cane sugar products. The process is relatively simple and an additional adventage is the fact that the same slide can be used for pollen analysis. Some of the honey samples from the market contained cane sugar particles. All the honey samples adulterated with cane sugar in Nepal also have high HMF contents.

Peroxide accumulation (glucose oxidase)

Average value for glucose oxidase was about 5 µg/g/hr at 20 °C, which is lower when compared to the *A. mellifera* honey of Nepal. Table 2 shows the glucose oxidase tests in 112 honey samples.

Table 2: *Glucose ocidase test.*

Peroxide value (µg/g/hr) at 20 °C	No. of samples
0	3
2.5	47
10	51
25	8
50	0

Diastase

Diastase value for *A. cerana* honey was between 5 and 22, with mean value of about 9 units.

pH and electrical conductivity

The pH values of all honeys was between 4.17 and 5.50. Similarly the electrical conductivity was between 360 and 1060 µSiemens/cm.

CONCLUSION

The conclusions from these experiments are:

1. The used low-tech and inexpensive methods give good and reliable results.
2. The analysis of honey from different localities of Nepal indicate that *A. cerana* honeys have their own properties which differ in certain characteristics from published data of *Apis mellifera* honey from Europe.

Especially the enzyme activity of cerana honey is lower, the pH is slightly higher and in some instances the sucrose content is higher and reducing sugar content is lower than for mellifera honey.

3. It was found that the general rule for the relation between HMF and peroxide accumulation holds. We found a better rule: if peroxide accumulation is more than 10 mg/g/hr at 20 °C, then HMF is even below 20 mg/kg.

The conclusions from our experiments are:

1. Low-tech and inexpensive methods give good and reliable results.
2. The analysis of honey from different localities of Nepal has indicated that *A. cerana* honeys have their own properties which differ in certain characteristics from published data of *A. mellifera* honey from Europe. Especially the enzyme activity of cerana honey is lower, pH is slightly higher and in some instances sucrose content is higher and reducing sugar content is lower than for mellifera honey.

3. It was found that the general rule for the relation between HMF and peroxide accumulation holds. We found a better rule: if peroxide accumulation is more than 10 µg/g/hr at 20 °C, then HMF is even below 20 mg/kg.

The final conclusion is that after starting the quality analysis the honey quality has gradually improved. Now adulterated honey is not brought to the lab and quality deterioration due to post harvest handling such as heating has been completely eliminated. Nevertheless, some adulterated and heated honey are sold in the market which has defamed the domestic honey. Thus, there is a need for legislation and nation wide quality control in Nepal. This may be carried out in a simple way by the above described program of analysis.

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BASIC REQUIREMENTS FOR QUALITY CONTROL OF HONEY IN DEVELOPING COUNTRIES

J.D. Kerkvliet

SUMMARY

A 5-Step method of analyses program with simple, low cost and easy to carry out methods was developed for testing the authenticity of honey, its possible adulteration and its compliance with legal regulations. The program involves determinations of (step 1) water content by refractometry, (step 2) sugar (invert and sucrose) by titration and/or polarimetry and/or microscopy, (step 3) HMF by photometry or visual colour comparison, (step 4) pollen and sugar cane plant cells by microscopy ('pollenanalysis') and (step 5) enzyme content by visual peroxide test.

Step 4 (microscopy) and step 5 (peroxide) are especially discussed.
In case of adulteration of honey with cane sugar, microscopy (step 4) of the honey sediment, obtained by centrifuging a honey solution, may reveal the presence of numerous characteristic parenchyma, sclereid and epidermis cells as well as single rings from ring vessels, originating from the sugar cane stem. Even a few percent of cane sugar adulteration may be detected this way.

Enzyme activity of honey is tested by the presence of hydrogene peroxide (step 5) in a honey solution, using a Merckoquant peroxide teststrip. If the peroxide accumulation is ≥10 mg/g/hr at 20 °C, then HMF is ≤ 40 mg/kg.

INTRODUCTION

Through the years the Food Inspection Service in Amsterdam has been more and more involved in the analysis of honey. This concerns not only trade honey but also honey from development projects in many countries, especially the ones where members of the NECTAR-group are operating.

Many times the question has reached us if there are some simple, small scale, low budget and 'low-tech' procedures to check the quality of tropical honey. Especially there is an interest to test the authenticity of honey, possible adulteration and compliance with the Codex or the EC regulations.

PROGRAM OF ANALYSES FOR QUALITY CONTROL

For this purpose the Food Inspection Service Amsterdam developed a program of analyses with reliable, simple and easy to carry out methods - without needing sophisticated equipment - giving a good impression of the quality of honey. It is a 5-step program including five main methods of analysis. Some of the methods are new, some are updated classical methods described in literature, however all methods are without the use of expensive black boxes/apparatus. In cooperation with the BETRESP project and Beekeeping Research Laboratory in Nepal, (reported by M. Shrestha in this proceedings) this program of analyses has been field-tested with good results.

For a more detailed analysis of honey, the diastase-index, the pH, and the electrical conductivity should also be measured.

On the other hand, under circumstances when a quick impression of the honey quality is sufficient, a short-cut may be made, thus only the analyses 2c: direct microscopic investigation of sugar crystals if present, 'pollen' and peroxide test may be carried out.

Table 1: Basic quality parameters for tropical honey

Program of analysis (5 steps)	Method of analysis	Legal regulations Codex	EC	Quality parameter
Water	Refractometry	≤ 21 % *	≤ 21 % *	Yeast growth.
Sugars				
Reducing sugars.	Titration.	≥ 65 % *	≥ 65 % *	Adulteration.
Sucrose.	Titration or	≤ 5 % *	≤ 5 % *	Adulteration.
Sucrose (high content).	polarimetry. Microscopy of sugar crystals.			Adulteration.
HMF	Comparision with standard (visual) or photometry.	≤ 80 mg / kg	≤ 40 mg / kg	Heating or adulteration.
'Pollen'	Microscopy on pollen, starch, cane sugar cells.			Authenticity, adulteration and filth.
Peroxide	Peroxide test strip (visual).			Test on the presence of enzymes, heating or adulteration.

* For some types of honey from specified botanical origin there are deviating values for water content and for sugars.

Step 1-3: Determination of water content (1) by refractometry, sugar (invert and sucrose) by titration and/or polarimetry and/or by microscopy (2) and HMF by photometry or visual comparison (3).

The analysis of water (moisture), step 1, is the classical method using a refractometer. It is used as the standard method all over the world and is described in detail by Anonymous (1989, and 1995), and White et al. (1988).

The analyses of sucrose and HMF are described in an excellent article on quality control for honey in less developed areas by White et al. (1988). Polarimetry is used for sucrose and a very simple photometric procedure with resorcinol/hydrochloric acid for HMF.

Alternatively both reducing sugars and sucrose can be determined by the classical titration as described in the Codex methods of analyses (Anonymous, 1988).

Admixture of honey with larger amounts of sucrose, mentioned under sugar in Table 1, can be seen directly by microscopical analysis of the crystallographic form of sucrose, which is quite different from the needles and plates of glucose, normally present in crystallized honey. In this way some 'honeys' have recently been discovered as fraud by simple one look through the microscope.

Step 4: Determination of pollen and sugar cane cells, by microscopy. Normal honey contains small amounts of pollen (between 10,000 and 400,000 grains per 10 grams), a well known criterium for the authenticity of honey. Microscopic analysis of the pollen present in the honey sediment is used for determination of the geographical origin and - in cases of centrifuged honey - also for the botanical origin of the product.

At the same time however microscopic analysis can reveal adulteration of honey with white or brown cane sugar, cane sugar syrup or hydrolized cane sugar syrup. In that case many parenchyma and sclereid cells, single rings from ring vessels and epidermis cells are present. These cells are very characteristic and originate from the stem of the sugar cane plant. They can be seen in the slide for microscopic analysis with normal light and even better by using polarization microscopy. Even a few percent of cane sugar may be detected in this way; such a low percentage can not be detected with any of the sophisticated 'high tech' procedures at the moment.

The method consists of preparing a microscope slide of the honey sample by classical melissopalynological procedures without acetolysis. Polarization microscopy, using crossed polars and a first order red retardation plate, which changes the background colour from black to wine-red, is the best method (but not the only one) for examing the slides. We reported in detail on this new and very simple method (Kerkvliet et al. 1995).

Recently 10 samples of honey bought on local markets in Nepal and the Philippines were found by this method as adulterated with large amounts of cane sugar; also a sample Chinese acacia honey imported this year in Europe was mixed with - in this case - a small amount of cane sugar.
The method requires only a microscope and is therefore especially useful for developing countries.

Microscopical analysis may also reveal other particles such as large amounts of starch: a Nigerian honey bought on a local market, was recently found to contain high amounts of banana starch, indicating falsification.

Step 5: Determination of enzyme content by visual peroxide test.
A new and very simple method to get an impression on the enzyme activity, heating, and authenticity of honey is the measurement of hydrogen peroxide accumulation, by using a peroxide test strip. Hydrogen peroxide is stemming from a heat-labile enzyme in honey: glucose-oxidase.

Most honeys do contain this enzyme. Upon dilution of honey with destilled water the enzyme becomes active and starts producing hydrogen peroxide, according to the following reaction:

$$\underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{water}}{H_2O} + \underset{\text{oxygen}}{O_2} + \text{enzyme} \dashrightarrow \underset{\text{gluconicacid}}{C_5H_{11}O_5COOH} + \underset{\text{hydrogen peroxide}}{H_2O_2}$$

The method of analysis is as follows: 10 gr of honey is dissolved in 40 ml of destilled water. After 1 hour one peroxide test strip Merckoquant (nr 10011, Merck, Darmstad, Germany) is dipped into the honey solution during one second and the obtained blue colour is read after 15 seconds by means of the provided colour scale. The obtained value, multiplied by 5, gives the amount of hydrogen peroxide accumulation in mg/g/hr at 20 °C.

If however the test strip does not give any blue colour but a zero value, the honey is not always suspected. There are at the moment three known causes for a zero or an extremely low value, namely:

1) The honey contains large amounts of the enzyme katalase (some type of honeys posses this enzyme,
2) The honey contains vitamine C (some types of honey have a rather high vitamine C content, e.g. thyme honey),
3) The honey is strongly heated or even adulterated.

In The Netherlands we now have experience with this method for 15 years, but only recently the method and the results were published (Kerkvliet 1994).

At our Food Inspection Service it was found that the following general rule applies for honey from *Apis mellifera* from all over the world:

> If peroxide accumulation (glucose-oxidase) is 10 mg/g/hr (20°C), then HMF is 40 mg/kg (and also diastase-index values are ≥8) with a probability of 95 %.

CONCLUSIONS

The described program with simple and easy to carry out methods gives a good impression of the overall quality of honey. Especially the microscopic method gives information on adulteration of honey with cane sugar, while the peroxide accumulation gives an impression of the enzyme activity and in many instances information on heating of honey.

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MEDICINAL VALUE OF HONEY IN NIGERIA

Kolawole Komolafe

SUMMARY

In Nigeria, only about 25 % of medicare is covered by modern allopathic practices based on Hippocratic principles. The remaining 75 % is covered by Traditional Medicine. Practically all Traditional Healers in Nigeria use honey in some of their preparations. The use of honey in medicinal preparations is rooted in the cultural history of the people. It goes back to the famous body of spiritual literature called 'Ifa'. Medicare and religion are strongly interwoven. The Traditional Healer is usually also the priest. Honey is used as medicine, but also in rituals, where the taste of honey is associated with health and happiness on earth. The use of natural honey for treatment of wounds, throat infection, chest infection, traditional bone setting, burns, arthritis, skin diseases, heamorrhoids and insomnia, and the use for cosmetic skin care, is discribed in this paper. The quality of African honey can be high because of the rich variety in natural flora, and because the environment remains relatively free from industrial pollution and from contamination with agricultural chemicals. Unfortunately, however, quality is often diminished by primitive honey hunting methods. Therefore, more people should be trained in the art of modern beekeeping.

INTRODUCTION

In the practice of herbal medicine and various forms of medicare systems all over the world, the use of natural honey continues to hold a position of prominent importance. Apart from the fact that various world communities have, in their cultural setting, recognized natural honey as medicine with its own merits, it is also a valuable constituent of many herbal and traditional medicinal preparations. Allopathy, Homeopathy, Naturopathy and other forms of modern therapeutic methods use honey in one form or the other in their day to day operations.

It is interesting to note that although the only officially recognized system of medicare in Nigeria is modern allopathic practice based on Hippocratic principles, this orthodox (official) system gives only about 25 % health coverage for Nigerians (Ayodele Tella, 1992). Invariably, the remaining 75 % of the health needs of Nigerian citizens is covered by Traditional Medicine. About 85 % of Traditional Medicine practice in Nigeria is herbal based while Therapeutic Occultism covers about 15 %. There are about 200,000 Traditional Healers of reasonable competence in Nigeria (Ayodele Tella, 1992). They are spread more or less uniformly in the rural and urban centers. In many rural settlements where modern doctors are scarce, the services of Traditional Healers (mostly herbalists) are highly valued and intensively used. Practically all the Traditional Healers in Nigeria use honey in some of their medicinal preparations.

It is also important to note that more than 80 % of medicines being used in modern, government recognized, clinics and hospitals in Nigeria are imported. A negligible proportion of these imported medicaments has natural honey as an ingredient. The imported medicinal syrups contain cheaper synthetic sweeteners since natural honey is more expensive and at times difficult to obtain in commercial quantities. It is clear that apart from a few government health centers and hospitals where pure natural honey is being used for wound dressing and research programs, the bulk of honey being used medically in Nigeria goes to the Traditional Medicine sector. One of the few governmental hospitals using honey for wound dressing on experimental basis is the University Teaching Hospital in Ibadan. Another government center is in Calabar. It is quite evident that the largest market for natural honey in Nigeria is in the medicare sector.

The confidence which the Nigerian Traditional Healer has in the use of honey in his preparations is rooted in the cultural history of the people. For example, the Yoruba people of Nigeria have rich historical records of the medicinal and spiritual values of honey in their famous body of spiritual literature called 'Ifa'. The Yoruba people believe that the honey bee was sent by God from an outer space planet (heaven) to this earth many thousands of years ago. They even assert that the bees first station on earth was a jungle called Ile-Igbon (Chief Alamu Gbotifayo). According to Ifa, when the bee did not produce "children" in Ile-Igbon (now a town in Nigeria, in Oyo State of Nigeria) she proceeded to another place called Shaki where she found many trees with holes in them. She settled in one of them, layed eggs according to God's injunction and nurtured the worker bees as well as the drones to maturity. As the population increased in the hive, she ordained other queens which swarmed with their colonies into holes in other trees. According to Ifa, the bees later swarmed to other parts of the world with a suitable environment. Hence, there are bees all over the world.

A verse in the second chapter of Ifa called 'Oyeku meji' has this to say about the bee and its honey:

OYEKU-MEJI
Koko igi male dain (Appelation of an Ifa priest)
Gbongbo igi male dimayan (Appelation of another Ifa priest)
Cast divination for Oyin (honey bee)
Divination was also cast for Ado (a type of bee)
Fuun-Fuun (another type of bee) was not left out
They were coming from Heaven for a life on earth
They all feared the eminence of disease and infirmity on earth
They were asked to make rituals of appeacement and sacrifice
On getting to the Earth
They were all free from disease and infirmity
As they were dancing in the home of Oyin (bee)
They were drumming in the home of Ado (a type of bee)
The home of Fuun-Fuun was not less joyous
Who does not know that the home of the bee is never bitter?
No one puts honey in the mouth and frowns.

The above Ifa literary and spiritual exposition portrays the average Nigerian's recognition of the values of honey, medically and socially. The average Traditional Healer in Nigeria applies the holistic approach to the treatment of his patient. The Traditional Healer who uses honey in his clinic is usually the priest who is often called to offer rituals and prayers with honey in social gatherings. The honey which the priest has blessed with prayers is passed amongst the audience for everyone to share the good taste of honey which is associated with health and happiness on earth.

WHAT IS IFA?

Ifa is a voluminous body of spiritual and historical Yoruba literature contained in 256 chapters. Each chapter is called an Odu. An Odu may contain more than 100 verses of educative ancient wisdom. A verse may also contain more than one hundred lines of poetic literature. Ifa literary corpus teaches ancient wisdom in religion, philosophy, medicine, botany, agriculture, engineering, geology, history and in fact all aspects of human existence in the universe.

Although some good attempts have been made in putting IFA down in writing in modern times, most of the wisdom still exists in the oral form being passed from generation to generation. However, there are a number of Ifa books from which an inquisitive mind can obtain useful information on the subject. Some of the useful and original publications with satisfactory English translations are:
- Sixteen Great Poems of Ifa sponsored by UNESCO and published in 1975 (UNESCO and Abimbola).
- IFA; An exposition of Ifa literary corpus published in 1976 by Oxford University Press, Ibadan, and authored by Wande Abimbola.

Ifa is one of the major subjects being offered by the International Institute of African Traditional Religions and Cultural Studies located in Lagos Nigeria. More information can be obtained through the author of this paper.

MEDICINAL USE OF HONEY

In the practice of herbal or traditional medicine in Nigeria, the law permits every traditional healer to compound his own medicine and use on his patients. Strictly speaking, the law recognizes a traditional healer only if the community in which he practices his art recognizes him. There is no standardization of skill or accreditation. Although some states like Lagos and Ondo have set up boards to control the practice of Traditional Medicine, a lot still needs to be done in the development of Traditional Medicine in Nigeria. Presently, there are no formal schools of training. Every practitioner invariably practices according to the dictates of his teacher and the rules of the association to which he belongs. The following exposition on the use of honey is therefore based largely on my own personal experience as a practitioner of both modern and traditional Medicine in Nigeria.

Wounds

Honey is a relatively cheap medicament for wound dressing. It acts as an antiseptic as well as a deongestant when applied to septic and oedematous wounds. Honey clears infected and dead tissue from the surface of old wounds leaving healthy granulation tissue that ensures rapid healing. It is also excellent for the treatment of fresh wounds like simple cuts and lacerations. With a single but sustained application of honey, simple fresh wounds may heal up in 7 to 10 days. For fresh wounds, natural honey has satisfactorily replaced the conventional iodine and Tincture Benzyl Co (TBC) in my clinic. For scalds and burns which commonly occur in home kitchens, immediate application of honey to the affected part prevents the formation of vesicles depending on the severity of the injury.

The major and only problem which I have found with honey in wound dressing is the burning and painful sensation which may be sustained for 10 or 15 minutes on a wound depending upon the extent or severity of the wound. The addition of palm kernel oil to natural honey reduces the burning effect of honey to a minimum depending on the proportion of mixing. A 1:1 mixture of honey and sterile palm kernel oil used on dirty wounds proves to be effective. A

1:4 mixture of honey and sterile palm kernel oil is good enough for clean wounds. Honey has proved to be very satisfactory for dressing chronic wounds of Haemoglobinopathy (Hb SS) patients.

Rashes

Honey application on measles and chicken pox rashes gives good results as the itching is reduced and the rashes heal up faster. It may be mixed with red palm oil which soothes the skin further and makes the patient restful.

Ear infection

A 1:1 mixture of honey and sterile palm kernel oil can be used as ear drops for ear infections. Pure concentrated honey used alone on the ear may irritate and harm the ear drum. It is therefore necessary to mix honey with a relevant material before using it for the ear. Natural honey is very irritating to the eye and should not be allowed to get there.

Cosmetic

Honey mixed with extracts of *Aloe veratum* (*Aloe vera*) is excellent for skin smoothness. Natural honey mixed with coconut oil, with or without *Aloe vera* is a good moisturizer.

Cough

Honey soothes dry cough and decongests the throat. It relieves laryngeal oedema which is a common cause of voice hoarseness in singers and public orators. Chewing *Garcinia cola* (Yoruba: Orogbo) with a mixture of honey and common salt satisfactorily relieves and prevents laryngeal oedema. This prescription is good for regular singers and orators. A mixture of honey with *Garcinia cola* and *Allium sativum* (Yoruba: Aayu) is a good expectorant for asthmatic cough.

Haemorrhoids

Pure natural honey is a good ointment for the treatment of haemorrhoids. Application of honey twice a day to haemorrhoids reduces congestion and relieves pain. When honey is mixed with powdered charcoal from maize hobs, it is more effective on haemorrhoids.

Insomnia and fatigue
A spoonful of natural honey mixed with a wine glass of water and taken at bed time gives a restful sleep after a hard day's work. This mixture may be made more effective by adding a few drops of *Citrus acida* (Yoruba: Osan wewe) juice.

Malnutrition
Natural honey is good for the treatment of malnutrition. A tea spoonful of honey in a pint of pure water (distilled water) is good for newborn babies awaiting lactation from the mothers' breasts. It is more nourishing than ordinary glucose water. However, dosage prescription has to be strictly adhered to, in order to avoid harmful irritation of the baby's gut. For older children, one or two tablespoonfuls added to local cereals enhances growth and health of the child. This prescription is currently very useful in Nigeria since most families can no longer afford the high costs of manufactured baby food. Children also benefit immensely from the use of honey in their food. For adults and very old people, honey is very nourishing. One or two tablespoonfuls of honey added on daily basis to geriatric diets gives excellent nourishment. However, honey should not for any reason be part of the diet of any diabetic patient.

Bone-setting
The inner surface of local bone setting and immobilising devices are coated with a mixture of wax and honey. If propolis is added the effect on the skin provides for a longer period before dead skin comes up. Unfortunately, the local method of harvesting honey (primitive honey hunting) does not give room for the isolation and recognition of propolis.

Arthritis
Natural honey may be used as ointment for aching limbs and joints. Dead honey bees gathered in the hive during honey hunting may be

grinded and mixed with honey for better effect on aching joints of rheumatism and arthritis.

VALUE OF AFRICAN HONEYS

Africa South of the Sahara is blessed with rich varieties of natural flora which provide the environment for the production of good-quality honey by the typical African bee, *Apis mellifera*. Another factor that contributes to the high quality of African honey is the fact that most of the African environment remains relatively free from industrial pollution, which reduces the quality of honey produced by industrialized nations. Comparatively, African nations use less of chemical fertilisers on farm crops. This factor also reduces the risk of honey being contaminated with agricultural chemicals and pesticides. A good proportion of African country vegetation and flora remains unpolluted. This adds a lot of value to African honeys.

Problems

It is unfortunate to note that most of the good quality honey produced by the African bee loses a lot of value through primitive honey hunting which involves aggressive burning of bee hives with wild fire. The poor methods of harvesting honey ultimately destroy some of the useful components of honey. The African honey hunter ends up harvesting burnt honey which is blackened by smoke and charcoal. The hive is so defaced that the average honey hunter is ignorant of how to identify components like royal jelly, the brood, propolis, ripe honey and unripe honey. The crude and primitive methods of harvest only give the opportunity of separating gross honey from blackened bee wax. These factors greatly limit the scope of medicinal usefulness of honey for the African traditional healer. You hardly find an African herbalist or healer talking of the medicinal values of royal jelly, propolis or bee venom. He can't use what he does not see. Such products have been destroyed or mutilated by fire during honey hunting.

Solution

The outstanding solution to these problems is to train people in the art of modern beekeeping. Developed countries can assist the developing ones in the area of training of modern beekeepers. In Nigeria, the efforts of a beekeeper and apiary instructor of the Netherlands, Chief (Mrs) Marieke Mutsaers, deserves recommendation. At the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria, she organized some training programmes for beekeepers. She also initiated the establishment of the Nigerian Beekeepers Association. I am glad to say that this association now organizes its own training programmes from time to time. Other African countries like Kenya, Uganda, Tanzania and Ethiopia also have laudable programmes for apicultural development.

CONCLUSION

It is pleasing to note that with the trend of improvement of honey production going on in Nigeria, the scope for the use of natural honey for medicinal purposes will also increase. It is equally certain that the value of African honeys will increase as soon as current efforts on training beekeepers start to yield the expected results in African countries.

On the medicinal value and use of African honey, a lot of research work still needs to be done, especially now that the production of honey through modern apicultural techniques is being encouraged in Nigeria and other African countries. The greatest problem here is the scarcity of material and financial resources needed for research. Aids and grants from developed countries are needed to allow meaningful research. I believe that the results of chemical analysis and research for the medicinal use of African honey will be of immense benefit to all mankind.

Finally, I thank the Netherlands Expertise Centre for Tropical Apicultural Resources (NECTAR) for giving me the opportunity to participate in this inspiring symposium. I am looking forward to a

future of further collaboration and cooperation between NECTAR and our institute for the benefit of our two countries - The Netherlands and Nigeria.

Thank you and may God bless you.

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THE COMPOSITION AND PROPERTIES OF HONEYS OF STINGLESS BEES (*MELIPONA*)

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SUMMARY

Nectar processing and honey storage in stingless bees and in *Apis* honeybees were found to differ markedly. Stingless bee honey is stored in large storage pots, whereas in *Apis* honey is stored in cells of the same size as brood cells. We found a distinctly higher water content in stingless bee honey. Particularly in the humid tropics, the high water content of the honey of the Meliponinae makes it vulnerable to spoilage. We also found that the honey of tropical honeybee had a higher moisture content than that of temperate *Apis*. The water content of stingless bee honeys was however still higher than that of tropical *Apis*. Honey samples from temperate honeybees contained on average 17.8 % water, Africanized honeybee honey from Trinidad 18.3 % water and *Melipona* honey on average 23.7 % water. Stingless bee honeys were further characterized by: significant lower pH, more free acids and the absence of diastase. The microflora of stingless bee honeys was characterized by the absence of yeasts and by the dominant presence of Bacillus. Stingless bee honeys possessed important antibiotic activity. Low pH and high sugar levels were found not to be important antibiotic factors: after dilution the antibiotic activity remained at a high level. Honeys with the highest *Bacillus* counts always had the highest antibacterial activity. Cultures of the specific bacteria isolated from nests of stingless bees grow well in honey solutions. In contrast other species of bacteria were not stimulated but were inhibited by the application of stingless bee honey. Our results explain the general and very wide-spread use of stingless bee honeys for medicinal purposes, for example in the treatment of burns, wounds and internal infections. The biological and applied pharmaceutical significance of these results is discussed.

INTRODUCTION

The importance of the storage of honey in nests of social bees

Of the estimated 20,000 species of bees (superfamily Apoidea), only a minority live in complex, highly social and perennial colonies. In the family of the Apidae, the stingless bees (Meliponinae) and the honeybees (*Apinae*) are the only two subfamilies containing species that live in large colonies, that store a considerable amount of food. The six species of the *Apinae*, all belonging to the genus *Apis*, are found in tropical and temperate regions. The Meliponinae (400 species) are exclusively tropical species. The stingless bees are often subdivided into the two tribes of the Meliponini and the Trigonini.

The fact that most social bee species are found in the tropics is explained by the lower costs of sociality in these environments. Living in a perennial colony requires a steady flow of food. In the evolution of highly "eusocial" bee colonies, therefore, the storage of food, rich in protein, fat and carbohydrates, plays an important role. The storage of pollen and honey makes it possible to bridge short interruptions in the food supply to the colony. In temperate regions with long dearth periods, there is a serious risk that food stores will become depleted, resulting in the death of the colony.

Use of honey harvested from bee-nests

The relation between man and bees dates back for thousands of years. What began as small-scale honey-hunting from wild nests in the forests, has developed into an apicultural industry in which beekeepers harvest and sell all kinds of bee products.

It is known from literature especially from the neotropics that ancient peoples recognized the special value of the stored products of indigenous stingless bees. The old Maya civilization used the honey, wax and resin of these bees. Great value was attached particularly to the honey (Weaver & Weaver, 1981). In the "meliponiculture" of Maya people, honey from the local stingless bee species *Melipona* *beecheii* was used to sweeten food. These ancient Indians also used honey of other species (most Trigonini) in religious rites and to treat skin wounds, ulcers, cataract, warts, cough, kidney diseases and intestinal infections. The honeys of various small-bodied Trigonini species were used for specific diseases.

At present, meliponiculture is still practised, especially in the neotropics and stingless bee honey is still used for the same purposes as in the olden days. The honey yield from most species is low, being often only one kilogram or less per year, just occasionally the yield is as much as 10 to 20 kg kg/year. However, the prices paid for these honeys are very high because they are believed to have special medicinal properties.

As a result of the problems that have arisen in apiculture due to the invasion of the aggressive africanized honeybees (AHB) in Central America, there has been a revival of interest in the traditional meliponiculture and the study of the biology of stingless bees among local beekeepers and bee scientists.

Stingless bee honey

There is a large variation between the approximately 400 species of Meliponinae with regard to body size, behaviour, nest architecture and food choice. It is not surprising that there also is considerable variation in the amount and the quality of the honey produced by the bees in this group, especially in the tribe of the Trigonini. Nogueira-Neto (1970) and Cortopassi & Gelli (1991) disriminated between various types of stingless bee honey on the basis of the flavour. They reported that many types of honey to tasted acid. , Besides using nectar from flowers to produce honey, some species of the Trigonini use a variety of other materials such as honeydew, fruits, sugar, mammal faeces, urine, sweat, fungus and liquids from dead animals. Consequently, their honeys are often not sweet, and sometimes they taste unpleasant and are even toxic. The composition of these honeys differs markedly from that of *Apis*. The species of the genus *Melipona* are also flower visitors and their honey is made from nectar and honeydew only, as is the case in *Apis*. Therefore it is better to compare these honeys, instead of those of the Trigonini, with *Apis* honeys.

Objective of this paper:

In this paper we will present the first results of our study on the composition, properties and antibiotic activity of the honeys of different species of *Melipona* and compare these to those of *Apis*. Besides reporting our results we give a preliminary explanation of the biological significance of the typical nectar processing, the honey storage behaviour and the specific honey composition in stingless bees. We will concentrate on the adaptivity of this behaviour in bees in tropical humid environments.
On the basis of knowledge concerning the biological activity of *Apis* honey, we will evaluate various mechanisms that determine the specific antibiotic properties of stingless bee honey.
We also give attention to the alleged medicinal properties of honey in general, and in particular of the honeys of stingless bees. We will discuss whether the characteristic processing of nectar is related to the alleged medicinal properties of this type of honey.

ORIGIN OF THE HONEYS AND GENERAL RESEARCH METHODS

We collected samples of honey of the following stingless bee species: *M. favosa* (Tobago; Trinidad W.I.), *M. trinitatis* (Trinidad: Rio Claro), *M. beecheii* (Costa Rica: Pozo Azul, Santa Cruz, Miramar, Heredia) and *M. lateralis* (Surinam) at different times of the year in the period of 1993-1995. A sterile syringe was used to extract honey from single honey pots, so that unripe and ripe honey would not be mixed. It also prevented the honey from being contaminated with cerumen from the honey pot or with any other nest material. Sugar concentrations were nearly always measured instantaneously in the field (Atago hand-held refractometer). For the other analyses the honey was transported to the lab in sterile containers. Some analyses were conducted at the laboratory of the "Keuringsdienst van Waren", Amsterdam, and the microbiological tests were performed at the Department of Microbiology of Utrecht University. Also a small number of honey samples from honeybees, *Apis mellifera*, were collected from colonies that were located near the stingless bee colonies in Trinidad. We analyzed some aspects of the chemical composition of the honeys. The antibiotic activity was measured and we also examined the honeys for the presence of micro-organisms. To study the conversion of nectar into honey we compared unripe honeys from open honey pots with samples from closed storage pots in nests of *M. favosa* and *M. trinitatis*.

RESULTS

Honey composition

We analyzed the composition of *Melipona* honey in order to determine the specific chemical and physical characteristics of these honeys compared to *Apis* honey. We concentrated first on measuring moisture since this appears to be a characteristic that differentiates *Melipona* honey from *Apis* honey. Moisture content was measured using a hand-held refractometer and corrected for honey sugars. Next, acid concentration and pH were measured. Free acid and lactonic acid concentrations were measured by titration (the total acid value being the sum of these) and values of pH were assessed in the lab by using a pH-electrode (Memotritator) or sometimes in the field by using pH paper. Hydrogen peroxide was measured because this component in *Apis* honey is probably responsible for the antibiotic activity (White et al., 1962). Hydrogen peroxide production was measured in honey at 20°C using a test-strip. Glucose, fructose and sucrose concentration were measured using standard enzymatic procedures. Gluconic acid was measured enzymatically in 1g of honey diluted in 100 ml aquadest with the use of a spectrophotometer. Differences between *Melipona* and *Apis* honeys were tested statistically with the t-Test.

Chemical composition

Moisture content in the *Melipona* honeys was on average 23.7% and was significantly ($t= 9.55$; $P< 0.001$) higher than in the *Apis* honeys: 18.4 % on average. The *Melipona* honeys had a lower pH than the *Apis* honeys and although the difference was not very large (averaging 3.53 and 3.68 respectively) the difference was also significant ($t=2.01$; $P=.026$). Free acid was significantly higher in the *Melipona* honeys than in the *Apis* honeys (39.63 and 5.67 meq/kg honey respectively; $t=4.922$, $P= 0.0002$) and as a result also the total acid level was significantly higher (39.63 and 5.67 respectively; $t=2.69$, $P=.011$). Further, we did not find any diastase in 5 different typs of stingless bee honey, whereas diastase is usually found in *Apis* honey.

There were no significant differences (at 5 % level) between the honeys of *Melipona* and of *Apis* with regard to the lactonic acid contents and the amount of hydrogen peroxide produced (both indirect measurements of glucose-oxidase levels) (Table 1).

Table 1: *Composition of Melipona and Apis honeys. Given are mean ± standard deviation; range; N.*

component	*Melipona* honeys	*Apis* honeys
moisture(%)	23.70 ±1.84; 20.3-28.1; 25	18.35 ± 1.13; 17.2-20.7; 13
pH	3.53 ±.24; 3.1-4.1; 21	3.68 ± .21; 3.5-4.2; 16
free acid (meq /kg)	39.63 ±11.57; 20.45-50.91; 10	5.67 ±1.31; 4.20-6.71; 3
lactonic acid (meq /kg)	6.18 ±2.19; 3.45-11.53; 10	18.78 ±5.92; 13.38-25.11; 3
total acid (meq /kg)	45.81 ±12.93; 23.9-56.88; 10	24.44 ±7.14; 17.58-31.82; 3
hydrogen peroxide (μg/g/h(20°C)	23.91 ±5.96; 10-31.25; 9	16.65 ±14.87; 0-50; 14
fructose (laevulose) %	31.08 ±7.35; 22.2-41.8; 8	
glucose (dextrose) %	27.49 ±4.27; 21.9-35.7; 7	
saccharose (sucrose)%	4.76 ±5.70; 0-13; 8	
ratio fructose/glucose	1.17 ±0.16; 1.01-1.5; 7	
gluconic acid %	0.43±0.13; .23-.59; 7	
diastase index	0; ; 5	

We were not able to analyse the concentrations of fructose, glucose, sucrose and gluconic acid in the *Apis* honeys. However, direct comparison is probably not the best way to test for differences, since total sugar content in stingless bee honeys is lower than in *Apis* honeys. Therefore we compared our measurements of the ratio between fructose and glucose with the average ratio in U.S. honeys of *A. mellifera* (White et al., 1962). We found no significant difference. Comparing our data with those of White et al. (1962)

however, we found a significantly higher water content and a significantly lower pH in our *Melipona* honeys as well as in our tropical *Apis* honeys, compared to temperate *Apis* honey.

Unripe honey

The results of an analysis on the pH and moisture content of open and sealed honeypots in two *Melipona* species are given in Table 2. As was expected, open pots contained honeys of a higher moisture content than closed pots, the difference being significant in the case of *M. favosa* ($t = 8.21$; $P < 0.001$). The pH of honeys was significantly higher in open pots than in closed pots ($t = 2.70$; $p = .004$) for *M. favosa*. In the case of *M. trinitatis* there was no significant difference in pH of honeys from open pots and from closed pots.

Table 2: *PH and moisture of open and sealed pots of two Melipona species. Given are mean ± standard deviation; range; N.*

characteristic	bee species	open pots	sealed pots
moisture (%)	*M. favosa*	24.07±3.40; 18.91-32.16; 34	23.47±3.202; 18.06-39.37; 233
	M. trinitatis	27.77±7.78; 21.24-43.82; 12	23.21±1.86; 20.5-26.54; 26
pH	*M. favosa*	3.99±.911; 3-6.75; 27	3.64±.26; 3.5-4.5; 59
	M. trinitatis	3.29±.39; 3-4; 7	3.49±.60; 2.5-4.5; 20

Microflora

In 19 out of 20 *Melipona* honeys we found pure cultures of spore-forming bacteria of the genus *Bacillus*, which were not identified down to species level. Very occasionally we also found yeasts in *Melipona* honeys, but there were only a few in each. The *Bacillus* counts were highest in 4 honeys that had a water content of >60 %, 47 %, 31 % and 40 % respectively.

Antibacterial activity

- Agar diffusion assay technique

In this technique 0.1 - 0.2 ml of honey is pipetted into hollows in an agar plate (L-agar), which had been previously infested with a microbial culture (0.1 ml. broth with fully grown bacteria, about 109/mm). After an incubation period (24 hr; 37° C.) we could determine the inhibition effect by measuring the clear zone around the point at which the honey had been applied.

The following bacteria were used as test organisms to assess the inhibition activity of honey samples: *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Escherichia coli* B, *E. coli* k12, *Bacillus* cereus. The growth of most of these bacteria was inhibited by both stingless bee honeys and *A. mellifera* honeys.

-Increase and survival of *E. coli*, *S. aureus* and symbiontic *Bacillus* in stingless bee honey

The increase in bacteria was monitored using a Klett photometer, measuring the increase in turbidity at 30 minute intervals for a period of three hours. The survival of bacteria was measured as follows. The bacteria were grown in broth medium and, when developed, were exposed to stingless bee honeys which were added to a 1 % concentration. After a three hour incubation period at 37 °C a quantitative measurement was made of the survival rate. For this 0.1 ml of culture was pipetted onto a new agar medium and the number of C(olony) F(ounding) U(nits) was counted.

We found that both *E. coli* and *S. aureus* increase in a growing medium when a small amount of stingless bee honey is added but that these bacteria were unable to survive after a few hours in these media. Undiluted stingless bee honey has a bactericidal effect on these bacteria species. In contrast, the symbiontic *Bacillus* isolated from stingless bee honey had an improved survival rate in media to which stingless bee honey had been added (Figure 2).

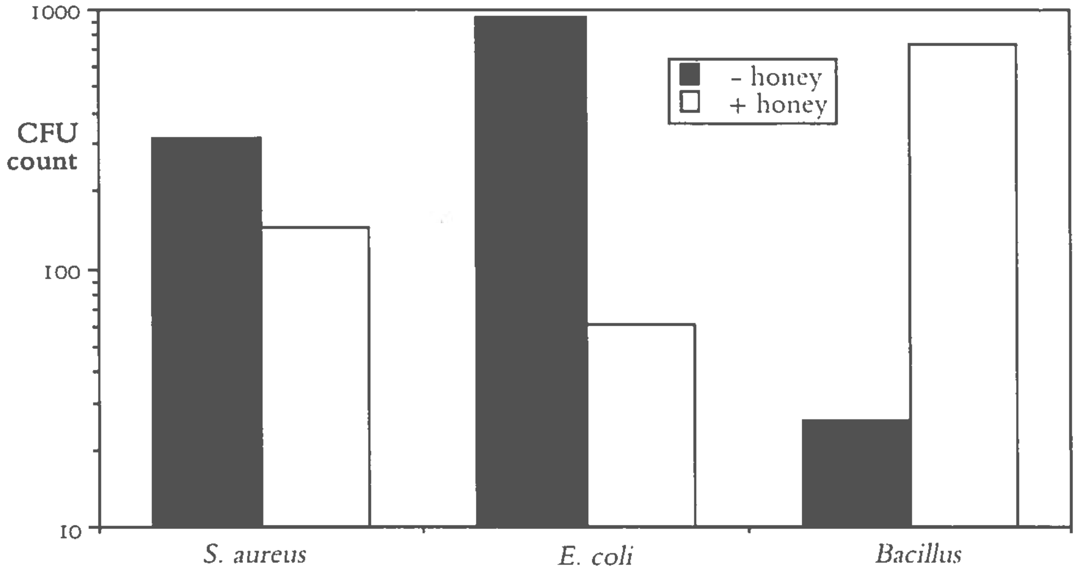

Figure 2: *Survival of different bacteria after the addition of honey: inhibition of S. aureus and E.coli in contrast to stimulation of Bacillus isolated from stingless bee honey.*

- Effects of stingless bee honey compared to iso-osmotic sugar solutions

Comparing the antibiotic effect of stingless bee honey solutions with iso-osmotic glucose solutions (25 %), we found that the glucose solution had a bacteriostatic effect (inhibiting bacterial growth). In contrast, the stingless bee honey solution at this concentration had a completely bactericidal effect (bacteria were killed).

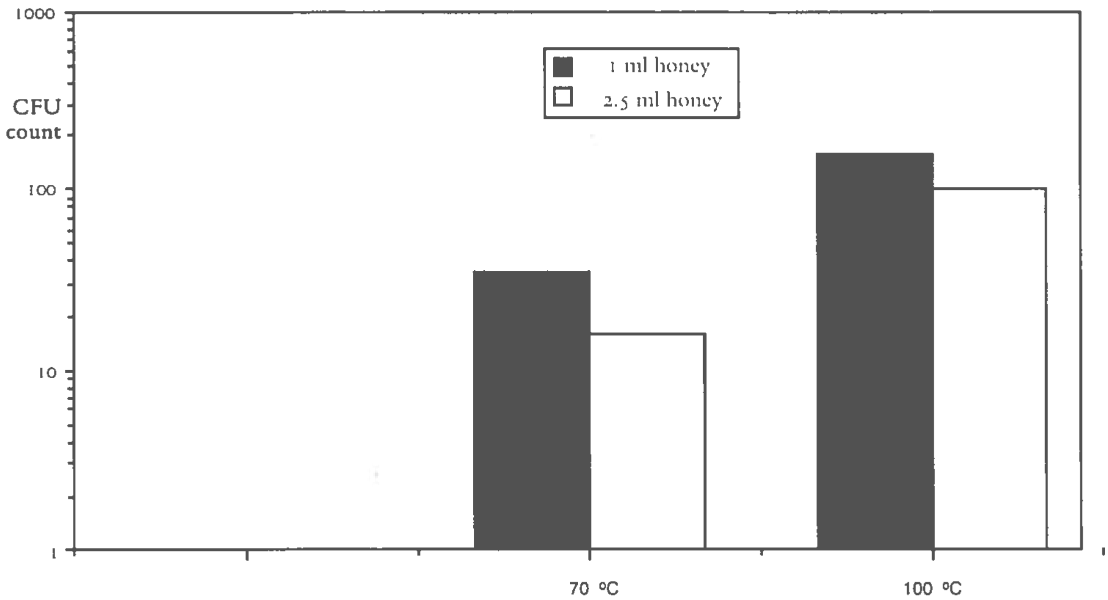

Figure 3: *Inhibiting effect of heating on the antibiotic activity of stingless bee honey: increasing temperatures lead to increasing survival rate.*

- Effect of heating on the antibiotic activity of the honey

The activity of stingless bee honey was affected by heating. After being heated to a variety of increasing temperatures, stingless bee honey demonstrated a progressive decrease in antibiotic activity and showed smaller or no inhibition zones with the agar diffusion assay and showed higher CFU-counts of *E. coli* K12 after 3 hours of incubation (Figure 3).

- Effect of adding catalase

The addition of catalase, which causes the breakdown of hydrogen peroxide, had no short-term effect on the reproduction of the bacteria. This means that hydrogen peroxide is probably not an important cause of the antibacterial activity of this honey. However, after a period of more than three hours, fewer CFU's were found in the solution without catalase (Figure 4).

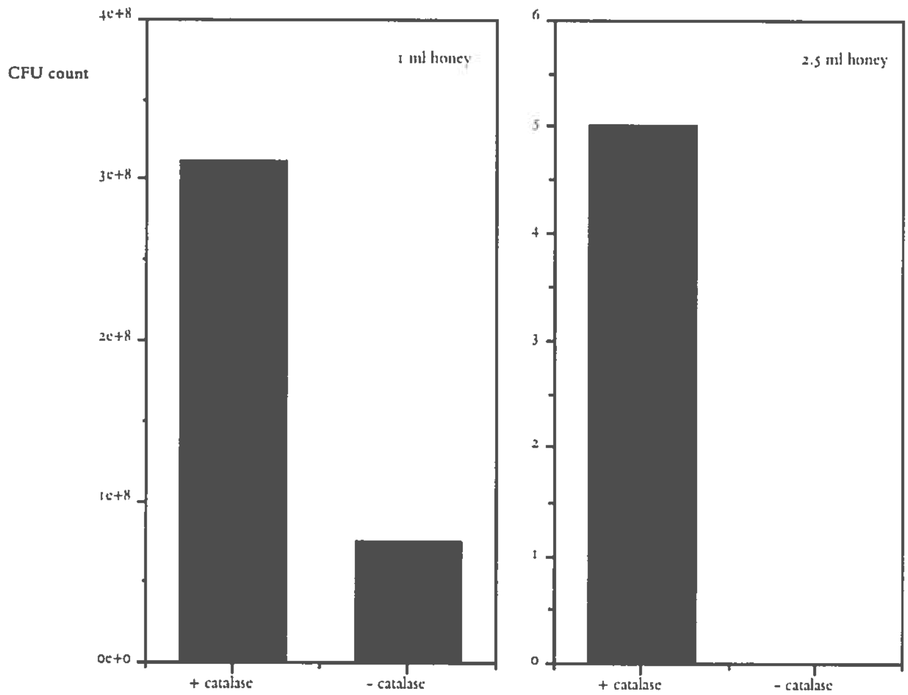

Figure 4: Delayed effect on the CFU count of the addition of catalase: after more than three hours survival is increased due to catalase.

- Effect of stingless bee honey compared to *Apis* honey

A dose-response measurement of *E. coli* K12 in the two types of honey yielded very different results. Stingless bee honey has a very strong bactericidal effect. The survival of *E. coli* in only a 5 % stingless bee honey solution was very low (only 5-10 % survival). Percentage of survival was calculated compared to a standard (no honey added). *Apis* honey of the same concentration permitted a much higher survival of *E. coli*: survival was 80-100% (Figure 5).

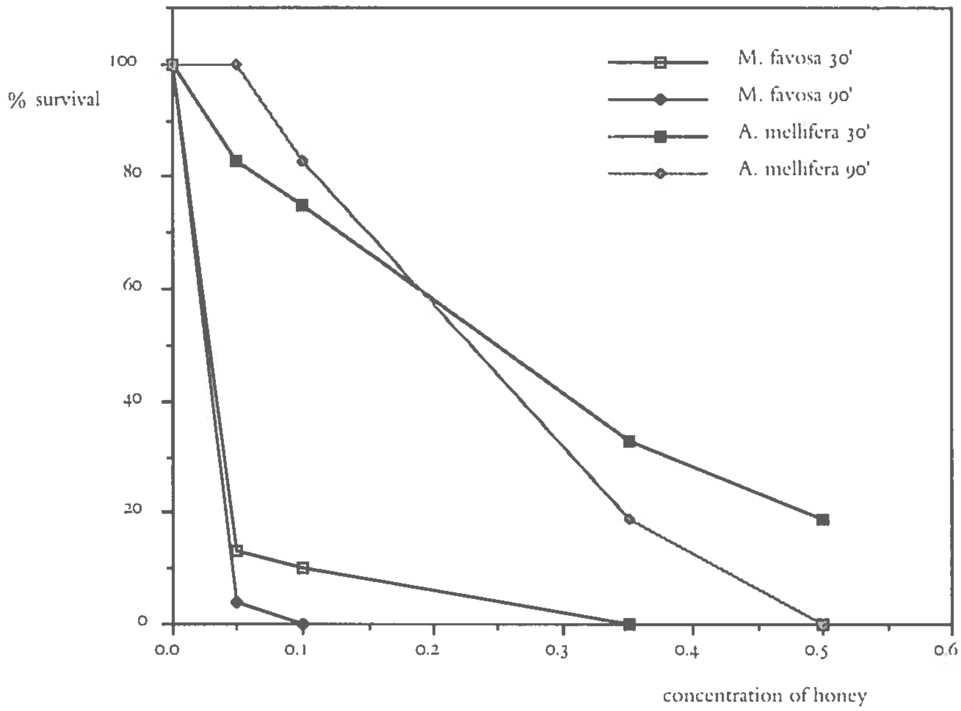

***Figure 5**: Inhibition of survival at different concentrations: inhibition is stronger in stingless bee honey than in Apis honey.*

- Different activity of various types of stingless bee honey compared to *Apis* honeys and a glucose solution

A comparison of the survival-% of *E. coli* cultures after treatment in different kinds of honey and a iso-osmotic glucose solution revealed the antibacterial activity to be highest in the *Melipona* honeys. The next highest activity was found in the tropical *Apis* honey, followed by the temperate *Apis* honey. The lowest antibacterial activity was found in the glucose solution. The honey samples from open storage containers were found to be more active than those from the closed honey storage pots (Figure 6).

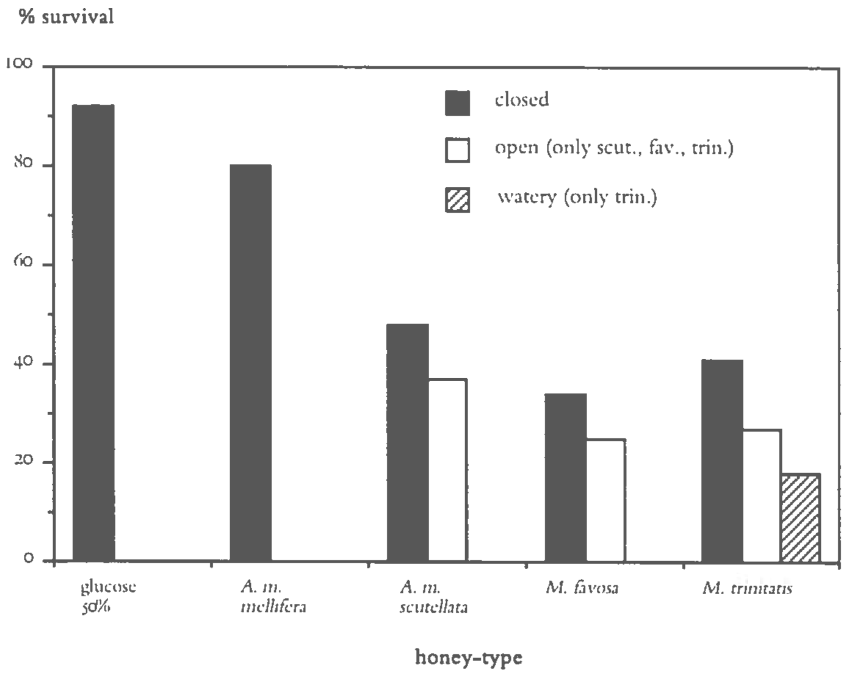

Figure 6: *Different antibiotic activity of various honey-types: 1 stingless bee honey more active than other types; 2 unsealed honey more active than sealed honey; 3 very watery stingless bee honey most active; tropical Apis honey more active than temperate Apis; lowest inhibition in glucose solution.*

DISCUSSION

Problems in the processing and the storage of honey in the nest

In general, stored honey is affected by adverse conditions: large quantities of carbohydrates are kept at relatively high temperatures. Together with moisture and exposure to oxygen, the environment is idealfor the growth of micro-organisms. There is a severe risk of spoilage of stored honey due to yeasts, moulds or bacteria. This risk is even greater in unripe honeys, since these contain more water. The physical and chemical characteristics of stored food and the physiological and behavioural adaptations of the bees all playa role in preventing spoilage. In addition, symbiosis with micro-organisms possibly is important in this.

Adaptations to prevent spoilage

a. *Apis mellifera*
In temperate *Apis*, the high sugar concentration is an important characteristic of the honey in that it prevents spoilage. The very low water content makes the honey hygroscopic. Micro-organisms cannot grow under this high osmotic pressure. With increasing water content, *Apis mellifera* honey will be subsequently infested by yeasts, fungi and bacteria. With a sugar content of more than 82.9 % no spoilage takes place. With a sugar content of between 80 to 81 % *Apis* honey does not spoil readily, but when the sugar content drops to below 80 %, spoilage will always occur.

While foraging on flowers, a worker honeybee adds a number of enzymes from its hypopharyngeal glands to the nectar that it carries in its honeystomach. One of these enzymes is invertase, which inverts saccharose into glucose and fructose. The solubility of glucose increases abruptly when the fructose concentration rises to more than 1.5 g per g. water in temperatures of 30 °C. The action of invertase thus leads to a higher sugar concentration than would have been possible otherwise. Another enzyme produced in the hypopharyngeal gland is glucose-oxidase which transforms glucose into gluconic acid and hydrogen peroxide. Gluconic acid lowers the pH of the honey. Hydrogen peroxide produces free oxygen and hydroxyl radicals, which in turn have an antibiotic effect. The enzyme diastase (=amylase) is probably important in the digestion of pollen. Upon arrival in the nest, the forager bee passes the nectar load to nestmates, who also add enzymes.

Water is evaporated from the nectar by a special behaviour of the house bees: they bring a small droplet of nectar from the honeystomach to their mandibles. By opening the mandibles, the nectar is dispersed in a thin layer. The glossa is moved rapidly through the nectar during fanning. In this way, the water content of the nectar can be lowered from 55 % to 40 % within an hour.
After this, the unripe honey is deposited in a cell which is kept open, allowing for subsequent evaporation. The process is enhanced by an

air current produced by fanning bees. Sometimes the honey is taken out and "dehydrated" as described above and put back again. Depending on temperature and humidity, the water content can thus be lowered to 17-20 %. Thereafter, the cell is sealed which prevents the subsequent absorption of water.

b. Stingless Bees

In the humid tropics the honeys of bees are more susceptible to spoilage, in view of the higher temperature and humidity. The typical high water content of honeys of the Meliponinae makes these honeys even more vulnerable. Yet, even these bees are able to store food for a prolonged period of time, without it being spoiled.

Nectar processing in stingless bees generally closely resembles that in *Apis* honeybees (Figure 1). We studied this behaviour in an experiment in which we offered a 50 % syrup to an individually marked colony of *M. favosa* (de Bruijn et al., 1989a). By dehydration behaviour resembling that in *Apis*, the bees can lower the water content of the nectar by 2 to 4 % per day.

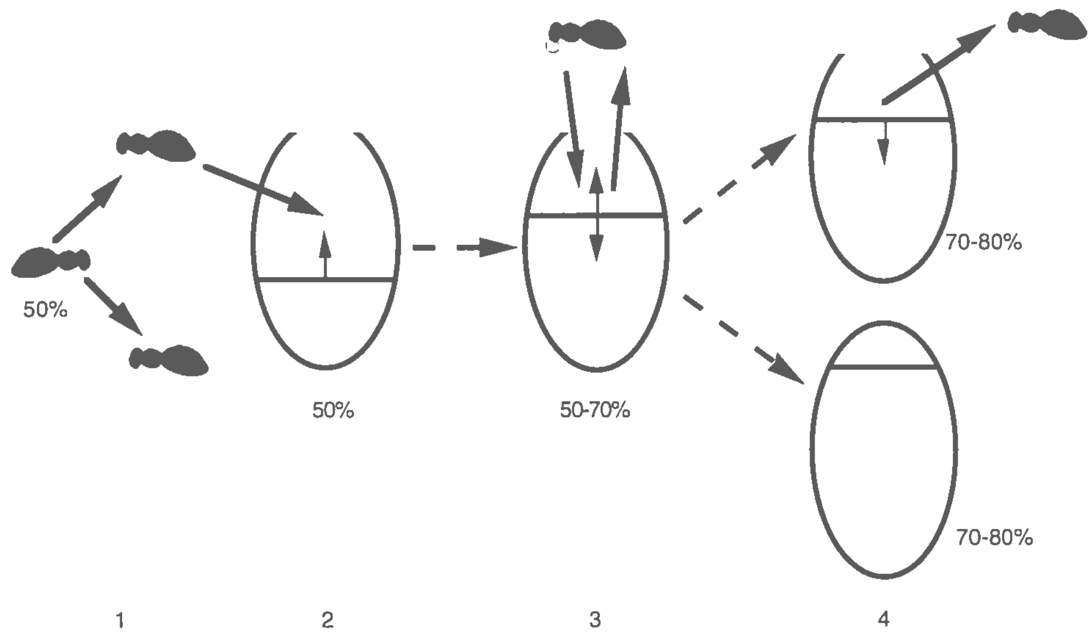

Figure 1: *Processing of incoming nectar in the stingless bee colony: 1 forager transfers incoming "nectar" to nest bees; 2 deposition of nectar in storage pot; 3 dehydration, leading to higher concentration; 4 storage or use of ripe honey.*

However, there are some important differences between *Apis* and *Melipona* with regard to food storage and nest architecture. Stingless bee honey is not stored in small cells arranged in combs, as in *Apis*, but in large honey pots that are arranged in clusters around the brood. Such clusters sometimes also contain pots carrying a very watery liquid.

The pots and other structures in the stingless bee nest are typically built of a material called cerumen. This is a mixture of bees wax and plant resin (Michener 1974, Roubik, 1989). Cerumen does not melt as easily as pure wax at higher temperatures and the incorporation of plant resin adds organic substances which are believed to possess antibiotic properties. Also unlike the nest of *Apis*, a stingless bee nest has a closed architecture: the brood compartment as well as parts of the storage pots are generally surrounded by waxy sheets (the involucrum) and the nest has only a small entrance hole. As a consequence, stingless bees will have more difficulty than *Apis* in regulating temperature and humidity inside the nest cavity.

In addition, stingless bees manage a waste dump inside the nest. Here, waste material, dead bees and workers' faeces are collected and manipulated. This behavioural characteristic is interesting since it entails a special risk involving the infestation of stored honey (de Bruijn et al., 1989b). Stingless bees probably overcome this risk by the controlled production of antibiotics. They can do this for example by producing antibiotics in glandular secretions. The finding by Baumgartner and Roubik (1989) that stingless bees collect carrion, faeces, and decaying animal tissue without risking infestations, point to strong antibiotic activity in the stingless bee colony.

Typical composition of stingless bee honey

Stingless bee honey turns out to be a product very different from *Apis* mellifera honey. From our results concerning the chemical and physical characteristics, it is clear that on average *Melipona* honey has a higher water content. Tropical *Apis mellifera* and A. cerana honeys are also known to have a higher water content than *Apis mellifera* honey from temperate zones. This higher water content principally is based on the climatic conditions of the habitat of these bees. We also found a higher moisture content in tropical honeybee honeys. However, we found the water content of stingless bee honeys to be even higher than that of tropical *Apis* (our samples of Africanized honeybee honey from Trinidad contained on average 18.3 % water; *Melipona* honey contained on average 23.7 % water).

The higher water content and the lower pH of stingless bee honey has also been reported earlier (Cortopassi and Gelli, 1991), but stingless bee honey also differed from *Apis* honey in another respect. The stingless bee honeys were further characterized by a significantly lower pH and more free acids. In addition the stingless bee honeys did not contain diastase, and contained a different microflora, characterized by the absence of yeasts and the dominant presence of *Bacillus*.

Analyses of factors related to/responsible for antibiotic activity in stingless bee honey

- Water content:
No micro-organisms can grow in fully ripe honey of *Apis*, because of the lack of free water. With increasing moisture content yeasts, moulds and bacteria will invade the honey successively . The moisture content of fully ripe stingless bee honey is significantly higher than that of *Apis* honey, and is at a level at which *Apis* honey would spoil immediately. However, these more watery stingless bee honeys do not spoil and are able to inhibit the growth of bacteria. Even after dilution the stingless bee honeys still possessed considerable antibiotic activity. We therefore conclude that a low water content cannot be the only important antibiotic factor promoting the conservation of stored honey of stingless bees.

- A low pH:
is a condition in which only a very limited number of micro-organisms can survive. Low pH thus could be a factor that explains the antibiotic activity of honeys. In stingless bee honeys pH levels are significantly lower than in honeybee honey and the antibiotic activity of stingless bee honeys does indeed tend to be higher. However, our

results clearly show that pH is not an important antibiotic factor in stingless bees honeys: after dilution, whgich causes a drastic change of pH, the antibiotic activity remained at a high level.

- Hydrogen peroxide:
in literature commonly listed as the most important resource for antibiotic activity in *Apis* honey and often referred to as the "inhibine" component (White et al, 1962), was also present in the studied samples of stingless bee honey. It is not clear whether this component is a major factor responsible for the antibacterial activity of stingless bee honey, since in the first three hours of our experiment the deactivation of peroxide with catalase did not diminish the antibacterial effect.

-Secondary plant components:
a. The hypothesis that stingless bee honeys may acquire their antibacterial activity through the diffusion of secondary plant substances from the cerumen walls of the storage pots containing honey (Roubik, 1983, 1989; Gilliam et al., 1985) may be falsified by our results. Assuming that honey in open pots, still containing more water than in sealed pots, has been in contact with the cerumen for a shorter period, on would expect the activity of such honeys to be lower than that of honeys stored for a longer period in closed containers. We found the opposite: the watery honeys from open pots were clearly more active.

b. Nectar of specific plants may contain an antibiotic effect which prevents spoilage already in the flower. Honeys collected by *Apis mellifera* from different floral resources have been reported to have different antibacterial activity, possibly due to peroxide as well as non-peroxide factors (Molan, 1992). Cortopassi and Gelli (1991) found that *Melipona* honey collected from *Mimosa* was more active than honey from other sources. However at this stage we do not know whether nectar collected by stingless bees from certain plants is already active at the moment of collection.

-Important role of Bacteria

Our results confirm the importance of bacteria as symbionts of stingless bees. The presence of bacteria was confirmed in all *Melipona* honey samples. The relation between bacteria and stingless bee honey seems to be very characteristic (Machado, 1971). *Apis* honey does not show significant and consistent bacterial counts.

In our samples of *Melipona* honey, all *Bacillus sp.*, were found at particularly high concentrations in the unripe honey. To prove the importance of the relation between bacteria and antibiotic activity, it is very important to note that the honeys with the highest *Bacillus* counts always had the highest antibacterial activity.

We explain this phenomenon in the following way. Stingless bees choose special micro-organisms and grow them intranidally. These bacteria are added to the honey during the ripening process. Particularly when the honey still has a high water content, these bacteria can grow and produce antibiotic substances. Later on, when moisture level is reduced, these bacteria can no longer be active, and in ripe honey only spores can be found. Possibly stingless bees also rely on a symbiotic *Bacillus* for the digestion of pollen (Gilliam, 1979).

An indication of the special nature of these bacteria is the fact that we found that their growth is enhanced specifically by honey solutions. Other species of bacteria are not stimulated by honey samples of low concentrations , instead these other bacteria are inhibited.

We hypothesize that the typical waste dump in the stingles bee nest and the food storage pots containing very watery liquids may be important for the survival of symbiontic bacteria in the nest.

Consequences of these results concerning application

Overcoming the problem of the spoilage of stored honey may be related to the medicinal properties of honeys. The inhibition of micro-organisms is an important issue in preventing honey from spoiling. Because of the very watery consistency of honey of stingless bees, a high degree of antibiotic activity is to be expected. This indeed is what we found. Our results therefore help to explain the consistent and very widespread use of these honeys for medicinal purposes, for example for the treatment of burns, wounds and internal infections. The confirmed antibiotic activity of these honeys requires further investigation since these honeys may be useful in the development of new medicines.

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MARKET FOR BEE PRODUCTS

MARKETING HONEY FROM VARIOUS HONEYBEE SPECIES IN VIETNAM

Dinh Quyet Tam

SUMMARY

In Vietnam both production and the number of *Apis mellifera* colonies have considerably increased from 1985 to 1995. Initially the export of this honey was hindered because of its high water content. Due to the improvement of bee management techniques and a price differentiation for honey quality, the water content was reduced. This resulted in an improvement of honey marketing and an increase in price. In 1995 90 % of the honey produced could be exported. The honey is mainly collected in the South of Vietnam from *Hevea brasiliensis*, *Nephelium lappaceum* and *Coffea robusta* and exported to U.K., The Netherlands, Japan, the United States and Asian countries.

Vietnamese honey is not contaminated by acaricides, because beekeepers only apply biotechnical methods to control the parasitic mites *Varroa* and *Tropilaelaps*. Ten percent of the *mellifera* honey is sold in Vietnam in retail to customers or in wholesale to the food industry or the traditional medical shops.

Honey harvested from *Apis cerana*, *Apis dorsata*, and very small amounts from *Apis florea* and *Apis andreniformis*, are sold domestically. Preferably honey with a high water content, and sometimes even fermented, is bought. Honey is considered as a valuable medicine. Although the living standard of the Vietnamese people is increasing, honey consumption is still 13 g/capita/year.

The Bee Research and Development Centre in Hanoi constructed and tested a dehumidification machine to reduce water content of the honey.

Small scale beekeeping with *A. cerana* is developing very fast, especially in the North and in central Vietnam. Because the domestic consumption does not increase export is necessary. Special honeys such as longan, litchi, jujube, coconut and others with a water content of 21 % show a good potential for export to other Asian countries and may even fetch higher prices because the customers' taste and habit in these countries is similar to those of the Vietnamese.

INTRODUCTION

Honey production and keeping bees for honey in Vietnam has already been mentioned in a famous document of the 8th century (Faraut, 1909). Beekeeping in Tonkin, Northern Vietnam, must have a long history because colony management was well developed, and because the beekeepers knew much about the bees' life and behaviour (Toumanoff and Nanta, 1933). Honey, used as a valuable traditional medicine for human use, was also described in an old medical book (Phuc, 1994). An investigation by Pasteur Institute and the Agricultural Institute in Tonkin in 1932 showed that beekeeping with *A. cerana* and collecting honey from *A. dorsata* was found in almost every village in the North of Vietnam. According to surveys in Southern Vietnam made between 1805 and 1836, 68 villages in the U-minh region had their main means of subsistence from *A. dorsata* beekeeping, paying their taxes in wax (Dau, 1991).

For a small country, Vietnam is abounding in honeybee species (Crane, 1989). *A. cerana*, *A. dorsata*, *A. florea*, *A. andreniformis* are native honeybee species whereas *A. mellifera* has been introduced (Otis, 1994). Vietnam is also rich in melliferous plants. The main nectar sources are *Hevea brasiliensis, Nephelium lappaceum, Euphorbia longan, Eucalyptus exerta* and *E. camaldulensis, Ziziphus jujuba, Eupatorium odoratum, Melaleuca leucadendron, Coffea robusta*.

At this moment about 180,000 colonies are kept in Vietnam, among them 110,000 are kept in movable-frame hives, 60,000 and 50,000 *A. mellifera* and *A. cerana* colonies respectively. The others are *A. cerana* colonies kept in traditional hives and *A. dorsata* managed with rafter techniques. The number of beekeepers reaches up to 10,000 and among them 1,500 and 300 *A. mellifera* and *A. dorsata* beekeepers respectively, the others keep *A. cerana* colonies.

In 1995 honey production in Vietnam reached up to around 2,520 mt of which 1,650 mt were exported. The rest is sold in the domestic market. Beekeeping development depends very much on aspects of honey marketing.

SITUATION OF APIS MELLIFERA HONEY PRODUCTION AND EXPORT

Quantity

So far, all exported honey is harvested from *A. mellifera*. The first honey lot of 50 mt with a water content of 22.5 % was exported to Japan in 1985 at a very low price. At that time, honey harvested from *A. mellifera* having a water content of 22.5 to 24 % was common, but led to difficulties with storage and export. To solve this problem, a project to improve honey quality was
worked out in 1987. The project covered the following beekeeping aspects:

- -Improvement of bee management techniques
- -Price differentiation for different grades of honey quality
- -Establishment of honey quality standards
- -Improvement of honey marketing

The project was prepared and successfully conducted in co-operation between the Central Honey Company (nowadays VINAPI) and KWT (Committee Science and Technology for Vietnam, The Netherlands) from 1987 to 1989.

The results of the project can be summarised as follows:

1. Honey quality was improved: the water content of honey has been decreased to 18 to 22 %.
2. The quantity of honey for export increased considerably with an increasing price.
3. The export honey market was extended.

In 1995, 1,820 mt of honey were harvested from *A. mellifera* occupying 72 % of the total honey production of the country, 90 % of which has been exported. Water content of the exported honey was below 21 %.

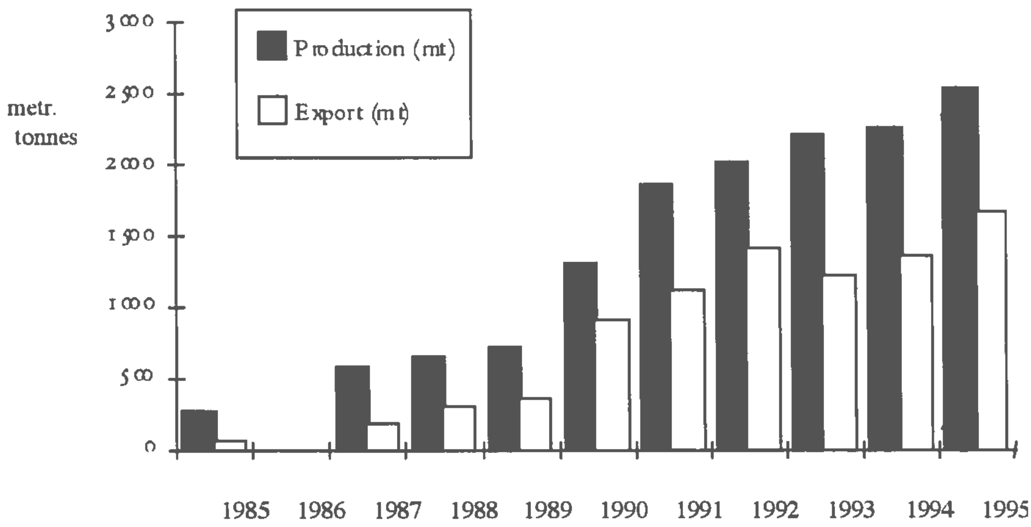

Figure 1: *Production and export of honey (mt) in Vietnam from 1985 to 1995. Source: Planning Department of Vietnam National Apiculture Corporation. 1995 (VINAPI, 1995*

So far, exported honey is mainly harvested from *Hevea brasiliensis*, *Nephelium lappaceum* and *Coffea robusta* produced by *A. mellifera* professional beekeepers in the South of Vietnam. The honey is exported to U.K., The Netherlands, Japan, United States and several Asian countries. At the moment, the demand of these importers is around 5,000 to 6,000 mt annually. Vietnamese honey is mainly exported in bulk, in drums of 300 kg net.

Quality
The existing colony management in Vietnam is aimed at obtaining as much honey as possible, without regarding the so called 'proper honey ripening and extraction methods' as described for *A. mellifera* in the Western world. Beekeepers tend not to wait until honey cells are sealed for a certain percentage. They do not use a 'honey super', so that most commonly combs are extracted which partly contain brood. Besides other causes this is one explanation for the high water content of Vietnamese honeys. These beekeeping habits certainly originate from traditional practice with the local hive bee *A. cerana* (Mulder, 1988).

One strong aspect of Vietnamese bee product is the absence of any residues of chemicals used to control mite pests. The Vietnamese beekeepers apply only biotechnical methods to control *Varroa* and *Tropilaelaps* (Can et al., 1989). Until now, bee diseases such as Chalkbrood and American Foulbrood have not been found in Vietnam.

In 1994, an experiment has been implemented in *A. mellifera* colonies by the Thu Duc University to compare the water content of sealed and unsealed honey. The results show that the water content of honey harvested from capped combs is 1.5 % less than that of uncapped ones. (23.5 % and 25 % respectively) (Tan, 1994). The experiment has been conducted during the longan nectar flow in April and May after the start of the rainy season.

Before delivery, all honey for export is strictly selected by the exporters before refining and packaging as well as controlled by the independent 'Inspection of Livestock Control and Veterinary Care (Tuyet, 1995).

Processing
Honey is extracted in the apiaries and transported in drums of 280 to 300 kg or plastic containers of 30 to 40 kg to the processing units.

There, it is refined by OAC or fine filter net. So far, honey processing units in Vietnam do not use heat to pasteurise the honey.

Export price

In 1995 the export price ranged from US$ 850 to 1,300 per mt. The rest of the honey from *A. mellifera* is sold domestically in retail to customers or in wholesale to the food industry or the traditional medicine shops.

Marketing potential

As mentioned above, the export demand exceeds present production while the potential of honey production in Vietnam is high. Nowadays, the tendency of using natural foodstuff and supporting environment-protection increases all over the world. This provides better opportunities for the development of export and domestic marketing. It is necessary to produce more kinds of honey that have a market potential. Areas of 250,000 ha Hevea, 118,000 ha of Coffea and around 200,000 ha of orchard (Cuc, 1995) may make it possible to harvest from 15,000 to 20,000 mt of honey annually. These plantations are concentrated in the western highlands, Red and Mekong river deltas where mainly poor farmers live. To exploit a larger part of the potential, a closer co-operation between the Government, local and international authorities is needed. Also research, extension service, technology transfer, finance, marketing and policy are important aspects in order to produce more honey for the markets and to create income and work for many more people.

HONEY FROM APIS CERANA AND OTHER NATIVE HONEYBEE SPECIES AND ITS EXPORT POTENTIAL

Quantity

An estimated 900 mt of honey are sold domestically each year. Among which 600 mt are collected from *A. cerana*, 100 tons from other species such as *A. dorsata* and very little from *A. florea* and *A. andreniformis*.

Quality

As far as quality is concerned, honey collected from native honey bee species has a very good taste and only a few kinds are less preferred (Toumanoff and J. Nauta, 1933). Preferably honey with a high water content and sometimes even fermented honey is bought in the domestic market. The typical colour, aroma, taste and the customer's habit are the main reasons why these honeys are sold very well. In fact, customers prefer 'local' honey of *A. cerana* or *A. dorsata* to *A. mellifera* honey with a low water content.

Most of the 'local' honeys do not crystallise. However, high water content (23-32 %) is the main problem of these honeys especially with respect to storage. Extracting honey combs that contain both brood and honey is the rule. Honey may therefore be extra watery, and contain more pollen. Beekeepers working with imported *A. mellifera* - only since the 1960's - have adopted this habit from traditional hive beekeepers, which is the most important factor that still escapes the attention of beekeepers to the honey quality problem (Mulder, 1989).

BRDC (Bee Research and Development Centre, Hanoi) constructed and tested a dehumidification machine to reduce the water content of honey (Table 1).

The experiment has been conducted under the following conditions: Air humidity: 65 %; ambient air temperature: 33° C; air temperature inside the machine: 60 to 62° C; air humidity inside the machine: 20 to 22 %; water content of the honey measured by hand-refractometer; HMF measured by UV-Spectrometer; the treatment duration of the honey was 90 minutes (Dung et. al, 1995).

Table 1. *Results of testing the honey-dehumidification-machine of the BRDC*
Source: Dung, et. al. (1995)

	Before treatment	After treatment
Honey temperature (°C.)	32	40
Water content (%)	.228	21
HMF (mg/kg)	.517	1.172
Honey weight (kg)	566.6	558.4
Colour	ELA	LA

Handling
Honey from *A. cerana* kept in movable-frame hives are extracted. Honey from *A. cerana* in traditional and top-bar hives, or hunted, and from *A. dorsata*, is usually squeezed by hand to separate the honey and wax. These honeys are simply strained through a nylon or cotton mosquito net and filled and packed in containers or bottles by hand in the apiaries. Sometimes, crystallised honey is heated to melt.

Price
In the domestic market, the honey is commonly sold in retail at around US$ 3.0 to 6.0 per kg. The rest is sold in the fairs or in shops in the vicinity of the town.

Potential of the export in the future
At present, with considerable support from the Government and International Non-Government Organisations, small-scale beekeeping with *A. cerana* is developing very fast especially in the North and in central Vietnam. The honey production increases to the level at which export is necessary because the domestic market gets saturated. Some special honeys such as longan, litchi, jujube, coconut and others with a water content of 21 % show a good potential for export to Taiwan, Malaysia, Indonesia, the Philippines and other honeys might fetch even higher prices because the customers' taste and habit in these countries is similar to that of the Vietnamese. Moreover, the demand of honey import is high in these countries. Present market price of several Asian honeys is around US$ 2.5/kg.

DOMESTIC HONEY MARKET AND SALE

Quantity
The domestic honey market consumes about 900 mt of honey from indigenous honeybee species and *A. mellifera* annually. Average consumption for honey is 13 g/capita/year. Honey consumption is higher in cities where people have a higher income as compared to

rural areas. Honey is well sold in Hanoi, Hochiminh city, Bienhoa, Vungtau, Danang and Hue.

Quality

Although in Vietnam, a quality standard for honey has been legally established, much honey is sold without label and therefore does not undergo quality control. In a year, only 250 to 270 mt of the honey is sold with labels and quality certificates from trading companies such as VINAPI, Hochiminh Honey Company, Dongnai Beekeeping Company and some medical factories. The Vietnamese consumers usually judge honey quality under this order of indexes as: colour, flavour, taste, consistence and their trust in the sellers. Most of the buyers lack knowledge on other honey quality aspects, so they are not interested in the composition of the honey. Sometimes, honey buyers apply simple old tests such as burning a match stick or piece of soft paper that was soaked with honey. This method may be only convenient to test water content in honey! Although, the water content of honey from native honeybee species is often higher than that of *A. mellifera*, Vietnamese consumers prefer honey of the former.

Consumption patterns

According to the tradition, Vietnamese people consider honey as a valuable medicine. They eat pure honey or mix it with some traditional medicinal herbs (Cau, 1987). Honey could strengthen human health, longevity and be effective in treating certain human illnesses and diseases, e.g. women after delivery (Phuc et. al, 1994). In many areas especially in the countryside, honey is used for first treatment of a burned or painful skin (Cau, 1987). Honey is also mixed with alcohol for drinking and to make soft drinks and cake (Cau, 1987). Honey used for cooking and producing cosmetics has not been paid much attention to.

Distribution channels

There are two main distribution channels for honey:

1. Beekeepers-wholesale to honey trading companies to collectors-consumers in retail (mainly *A. mellifera* - beekeepers)
   The honey trading companies belong to the state, honey-collectors work privately. Honey is packed in glass bottles of 65 cl and sold in pharmaceutical shops and honey stands with a label indicating the name and address of the trading company. The retail price is US$ 1.5 to 4.0 per bottle of 65 cl. This bottled and labelled honey is popular in large cities. Only 30-32 % of this honey is consumed in the domestic market.
2. Beekeepers (or honey hunters) to consumers in retail
   Honey is often sold directly from the apiaries and packed in any container which the seller or buyer has. The beekeepers and their family members sometimes bring the honey to a fair for sale. This honey is very popular in the countryside and small towns being 70 to 78% of the honey sale in the domestic market. So far, all small-scale beekeepers sell the honey harvested in the same year. It is difficult to control the honey quality. Selling and buying is based on mutual confidence. The retail price is US$ 3,0 to 6.0 per kg.

Demand for honey

During the last 10 years, honey consumption has increased 4.5 times: from 200 mt (1985) to 900 mt per year (estimated 1995). At present, the living standard of the Vietnamese people is increasing year by year. However, the honey consumption is still low, only 13 g/capita/year. Considering honey consumption e.g. in Malaysia, Taiwan, Philippines and the local market in the past years, we predict that honey consumption in Vietnam will continue to grow in the near future. In order to meet this growing demand of the consumers, it is necessary to develop honey production and improve honey quality, packaging and certain processing facilities to diversify the value-added to honey based products.

At this moment, some kinds of packed honey are imported from foreign countries and sold in several Food Import Shops in Hanoi and Hochiminh city at a very high price of US$ 3.00 to 4.00 per jar of 450 g.

PROBLEMS

- Honey productivity of *A. mellifera* (25-28 kg per colony) and *A. cerana* (4-10 kg per colony) is still low.
- The potential of beekeeping has not yet reached full exploitation.
- Water content is high (*A. mellifera* 21-22 % and *A. cerana* 23-32 %) which needs to reduced.
- The exported honey is only bought by a limited number of traders.
- Honey consumption of 13 g/capita/year in the domestic market is low.
- Honey is exported as bulk foodstuff at a low and unstable price.
- Appropriate techniques and equipment to improve honey packaging and to diversify honey products are not yet available.
- Proper techniques and equipment to identify pollen in each kind of honey are inadequate.

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APPENDIX

Trading Companies in Vietnam:

Vietnam National Apiculture Corporation (VINAPI)
Lang ha, Dong da, Ha noi
Tel: +84 48343 185; fax: +84 48352 725.

Apiprodex Saigon
264H Le van Sy str., Distr. no. 3, Hochiminh city
Tel: +84 8 444 231; fax: +84 8 440 687.

Hochiminh Honeybee Company
Nguyen van Trang, distr. Phy nhuan, Hochiminh city

Dong nai Beekeeping Company
Road no. 15, Bien hoa town, Dong nai Province

POSSIBILITIES AND CONDITIONS CONCERNING MARKETING OF TROPICAL HONEY THROUGH MAX HAVELAAR/TRANSFAIR SEAL

Jos Harmsen

SUMMARY

One of the main reasons for many problems in the third world is the way the world market is functioning. Primary producers do not really benefit. By implementing 'trade not aid' on a large scale, the Max Havelaar foundation supports small-scale producers in their efforts to build up a dignified and human life. This means that we help to get fair traded coffee, cocoa and honey in the mainstream market. Max Havelaar is not buying and selling honey herself. It is a quality seal, which is only given to importers if the trading conditions of Max Havelaar are met. The role of Max Havelaar is promotion of the seal to consumers, checking whether importers buy honey according to the conditions for the seal, and keeping a register of small-scale beekeepers who produce the honey.

INTRODUCTION

There are people who call honey 'yellow gold'. But for whom? Not for everybody involved in the production it is all gold that glitters. As with many commodities, the primary producers do not really benefit from their own produce, but rather the people who trade in honey. This is why Max Havelaar started her activities.

COLLECTING MONEY OR A MORE STRUCTURAL APPROACH?

There is a wide gap between rich and poor countries. In the rich countries we always had the feeling we should somehow help. Big events on television were organised collecting millions of guilders. For Bangladesh because of floods, for Africa because of drought, for Peru because of a cholera disease or elsewhere because of an earthquake, etc. Recently there was the initiative for Rwanda because of the war and the many refugees living in camps. However, many people feel that it is useless to send money. "It doesn't help", they say, "because after some years the same problems will arise again". I think we have to continue with this help, however, because it is useful and we cannot stop helping people living in the same world.

On the other hand, we have to work towards a situation in which this help is less needed or will become redundant. We have to create a situation that people in the South can solve their own problems. In fact, a more structural approach of Third World problems. That approach has been the starting point of the Max Havelaar Foundation.

We think that the trading conditions on the world market are not fair, and that the way it is acting is one of the main reasons for much of the problems in the Third World. Producers don't have a chance to participate in trading, especially the small growers/producers. They are pushed to the outside positions and are the first victims of the common way of trading.

Actually, Max Havelaar was not our idea but an idea of the small-scale producers themselves. In 1986 Mexican coffee growers told us: "Of course it's very good that you give us money to build a school or buy a truck, but it is much better to pay a good price for our products, for our coffee". "If you do like that, donations are no longer needed because we can solve our own problems". In fact they were asking for better trading conditions. In other words 'Trade not

Aid', though it may be better to speak of 'Trade and Aid'. The Max Havelaar Foundation wants to support small-scale producers in the Third World in their efforts to build up a dignified and human life by implementing 'trade not aid' on a large scale. We started with coffee in 1988, added cocoa/chocolate in 1993 and introduced honey in 1995.

On November 15th 1988, our chairman-in-honour Jan Tinbergen, who has received the Nobel-prize for Economics and who just died this year, presented the first packet of coffee to Prince Claus, the husband of our queen. Now you can buy this coffee in 90 % of all supermarkets. Cocoa was added to the assortment in 1993, honey was added this year.

IS MAX HAVELAAR A NEW MODEL?

You may argue that selling of coffee, chocolate, honey and other products directly purchased from farmers already existed. So what's new of the Max Havelaar initiative? In the past such products were only sold in churches, in Third World shops, on special markets, and always in very small quantities. To give more real support, increasing sales are necessary. This can only be achieved when you sell the products on places where people usually do their shopping. In the Netherlands that is the supermarket in the big shopping centres. Third World shops are often situated in the outskirts of the towns and are not always open because they are usually manned by volunteers. Thus, Max Havelaar was founded to achieve that coffee, chocolate and honey from farmers in the third world directly reaches the mainstream-market.

THE TRADING CONDITIONS OF MAX HAVELAAR

When small producers do not benefit from trade, the trading conditions have to be changed. So we have set the following conditions:

- All honey should be purchased directly from organisations of small beekeepers. Usually, importers buy the honey from exporters, who buy it from national traders, who buy it from regional traders, who buy it from local traders, who buy it from small-scale beekeepers. The beekeepers only get a small portion of the world market price. Small-scale farmers don't have a choice. Far from the centres they don't have means of transport, etc. The intermediaries are abusing this situation by offering very low prices.
- To give farmers a chance to develop themselves they should get a good price for their honey, a price which covers all production costs, allowing members and their families adequate living conditions, and leaving producer organisations with a margin to pay for supporting services to beekeepers and social development activities within the community. It means that we never pay less than US$ 1550 FOB/mt. For certified organical honey a premium of US$ 200 is added.
- When beekeepers bring their honey to the co-operative they must be paid directly otherwise they prefer selling at intermediaries, even against a lower price. In their circumstances they don't have a choice as their need for cash is urgent. Therefore, under Max Havelaar conditions the co-operative may be financed in advance: credit facilities up to 60 % of the contract price on request of the co-operative.
- The relationship between importers and producers should be for the long term, to provide income security.

When all the honey is bought under these conditions, the right to use the Max Havelaar Seal can be given. In this way, beekeepers have the opportunity to work on their subsistence and development, to solve their problems. These conditions have to be seen as a package. You cannot miss one of them. What is the use of high prices when (1) the main part is going to the traders, (2) you are not certain that you will get a reasonable price next year, and (3) co-operatives cannot pay the farmers directly. In short, Max Havelaar tries to create conditions in order to give beekeepers the opportunity to build their own future. For us, that is real development; real empowerment of the poor. In addition, also the way of trading is different. It is based on an equal relationship, and it gives producers hope and the feeling they can do it themselves.

THE MAX HAVELAAR SYSTEM

Let us look closer into the Max Havelaar system and the way it is organised. Max Havelaar is not buying and selling honey herself. Max Havelaar is just a quality mark, a seal (Figure 1). We decided not to duplicate capacities already available. Every party involved in the market has its own specific expertise and potential. These capacities we want to be incorporated in the initiative, thus:

- small producers keep the bees
- processors bottle the honey
- wholesalers and supermarkets distribute the honey
- consumers support the poor by buying honey.

All together we are working on the common goal. Max Havelaar is only engaged in a part of the chain from producer to consumer. Since we are not engaged in buying/selling of honey, and not in production, what is the role of the Max Havelaar Foundation?

Promotion

Promotion is directed to make consumers buy more honey with the Max Havelaar seal. So, we are not promoting marks of honey, only the Max Havelaar Seal.

Figure 1. Quality seals used by Fair-Trade organisations in different countries.

Relation to licensees

We make contracts with the European importers that want to use the Max Havelaar seal. The accounts of the importers are audited. The importers have to show the contracts with the organisations of producers. Using the contracts, the number of bottles of honey sold to the wholesalers or supermarkets are checked. The quantities should correspond with each other. In addition, we collect information from the producers, the beekeepers themselves.

Relation to producers

We also make contracts with the producers. They have to meet the following criteria:

- Small-scale production. Beekeepers in our initiative produce on average 150 kg. They mainly manage the bees themselves with the help of their family. The reason for this is that these producers will invest in their own village.
- Democratic organisation. Member beekeepers check their own organisation and decide how to use the extra revenues of the Max Havelaar sales.

All the producer organisations are included in a register of producers. Importers are only allowed to buy honey from beekeepers in this list. At the moment, 13 co-operatives from 6 countries are included (Guatemala 4, Chile 3, Mexico 3, Uruguay 1, Nicaragua 1 and Tanzania 1). In total some 15,000 members.

European collaboration and products

Max Havelaar is not the only Fair-Trade initiative. Similar initiatives have been established in other countries. Selling of honey has been introduced in Switzerland and the Netherlands and is about to start in Germany. Max Havelaar-Netherlands works closely together with the other national initiatives (Table 1). We all use the same trading conditions and share the register of producers. In the Netherlands we co-ordinate the register for coffee growers. The register for honey producers is co-ordinated by TransFair International in Germany. There you can obtain more information.

Table 1. *Fair-Trade initiatives in the mainstream market.*

Country	Year	Name initiative	Coffee	Cocoa	Tea	Honey
Netherlands	1988	Max Havelaar	+	+	-	1995
Belgium	1991	Max Havelaar	+	-	-	-
Switzerland	1993	Max Havelaar	+	+	+	1994
France	1993	Max Havelaar	+	-	-	-
Germany	1993	TransFair	+	-	+	1996
Luxemburg	1993	TransFair	+	-	-	-
Great Britain	1994	Fairtrade	+	+	+	-
Japan	1994	TransFair	+	-	-	-
Austria	1994	TransFair	+	-	+	-
Denmark	1995	Max Havelaar	+	-	-	-
Italy	1995	TransFair	+	-	-	-
Canada	1995	TransFair	-	-	-	-
Sweden	1996?	?	-	-	-	-
Norway	1996?	?	-	-	-	-

RESULTS OF SELLING HONEY WITH THE MAX HAVELAAR SEAL

Honey with the Max Havelaar seal is sold in Switzerland (since 1994) and in the Netherlands (since 1995), and it will start in Germany at the end of 1996. Since selling of fair-traded honey just started, the sales are still quite small (Table 2). In the Netherlands there are two licensees and the honey is sold in health shops and Third World shops. It is not yet sold in supermarkets, but we are still at the beginning of the honey initiative. In the near future we expect a growth of the honey initiative: sales in the supermarkets, more licensees, etc. We are sure that the trend of selling honey with the Max Havelaar seal will be like that we achieved before with selling coffee.

Table 2. *Sales of fair-traded honey (mt).*

Country	1994	1995	1996
Netherlands	-	80	100
Switzerland	230	250	300
Germany	-	-	700
Total	230	330	1100

APPENDIX

For more information:

TransFair International
Am Ochsenberg 16
73614 Schorndorf
Germany
tel: + 49-7181-65417 fax: + 49-7181-65546
E-mail: tfi@oln.comlink.apc.org

THE WORLD MARKET IN RELATION TO TROPICAL HONEY

Andrew Matheson

SUMMARY

Only c. 17 % of the world's honey is produced in the tropics. About the same proportion of the 250,000 to 300,000 tonnes of honey traded internationally every year originates in the tropics, but the vast majority of this comes from only two countries: Australia and Mexico. Exports from other tropical countries are limited by the high local-market prices often paid, the difficulties for small exporters to establish reliable markets, and quality problems. Opportunities do exist, though, for exporting particular types of honey into the niche markets in developed countries. This paper also considers the effects on the honey market of the sanitary and phytosanitary agreement recently concluded as part of the Uruguay Round of the general Agreement of Tariffs and Trade (GATT).

INTRODUCTION

This paper looks first at the world honey market; the principal producing, exporting and importing countries, and the role of the tropical regions in this market. Then I look at some limitations which prevent tropical honey from playing a more important part in the world market, and some opportunities for honey producers in the tropics to become more involved in exporting. Finally I look at recent developments in liberalising international trade, and how these might affect tropical honey producers.

World honey production

Of the seven most important honey producing countries in the world (Figure 1) only one has significant areas falling within the tropics, Mexico. Calculating the proportion of the total world honey production arising from the tropics is made difficult by the lack of accurate statistics, but I have made an estimate based on the FAO (1994) figures and two assumptions: that 50 % of Australia's honey and 67 % of Mexico's comes from the tropics. This calculation suggests that only 17 % of the world's honey is produced in the tropics.

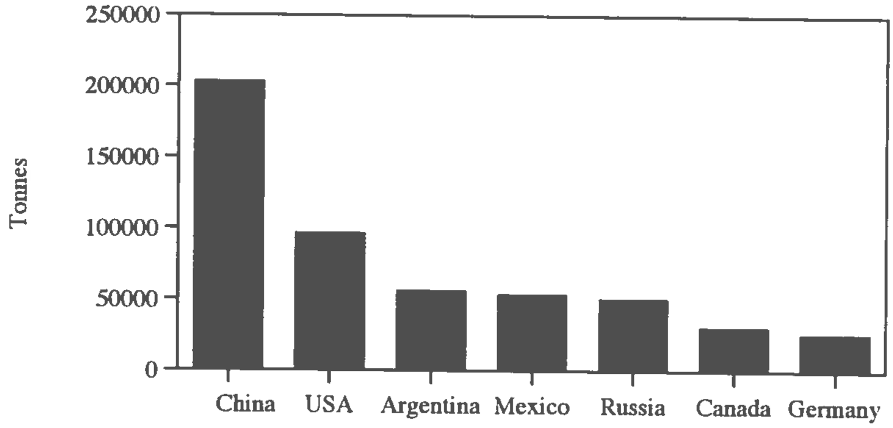

Figure 1: Major honey-producing countries of the world (1992-1993 average).

World honey trade

The five principal honey-exporting nations are given in Figure 2. Two are partly in the tropics; Australia and Mexico. Honey importing information is given in Figure 3: most honey is imported by the European Union (EU), especially Germany, and the USA and Japan.

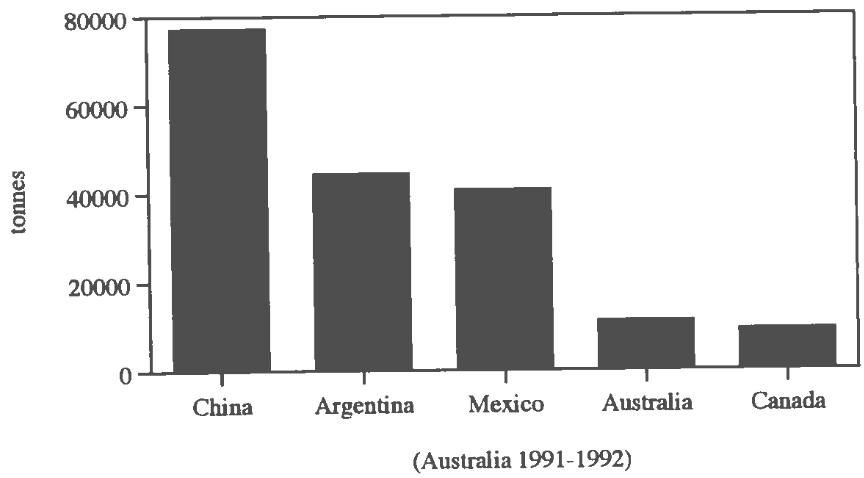

Figure 2: Principal honey-exporting nations (1991-1993 average).

There are different patterns in the international honey trade. Some countries consume almost all their production internally (e.g. Russia which, incidentally, used to be a major exporter of honey). Others export almost all of their production, such as Argentina and Mexico. For some countries almost all their honey is imported (e.g. Japan), while others both import and export (e.g. Germany).

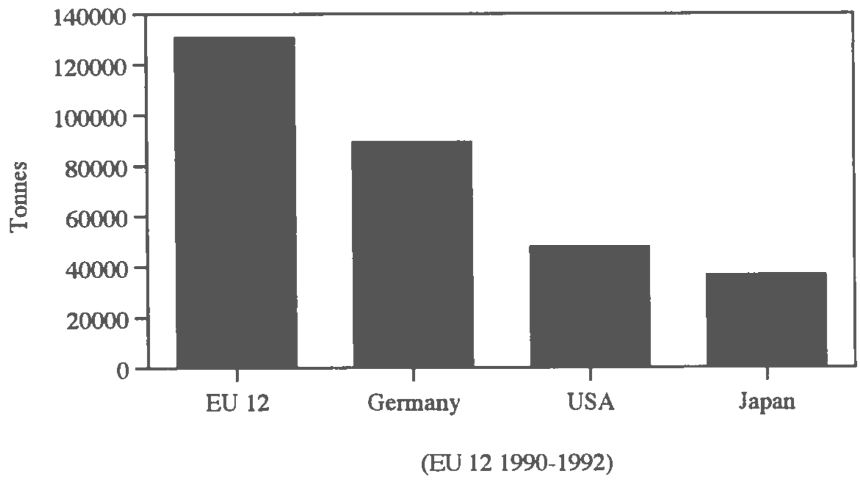

Figure 3: Principal honey importers (1992-1993 average).

Applying the same assumptions about Mexico and Australia as used in the previous section, only 17 % of the exports of the major exporting nations is derived from tropical areas. Thus, tropical countries have a share of the international honey trade in proportion to their production levels, but it depends almost entirely on two countries.

More accurate figures are available for imports to the EU. Using the same assumptions for Mexico and Australia but using accurate import figures for honey from other tropical countries, 21 % of the EU's honey imports in 1994 came from the tropics. It should be expected that this figure is higher than the global average, because of the historical links from colonial times between several EU states and many tropical countries.

LIMITATIONS FOR TROPICAL HONEY IN THE WORLD MARKET

Several factors have prevented honey from tropical countries expanding its share of the world market.

Price

The world market for honey is low, and during 1993 and 1994 the average c.i.f. price for honey imported into both the EU and USA was less than $US1,000/ton (Figure 4). Prices have increased during 1995, mainly because of political changes in the US market, but have returned only to about the same level as in 1992.

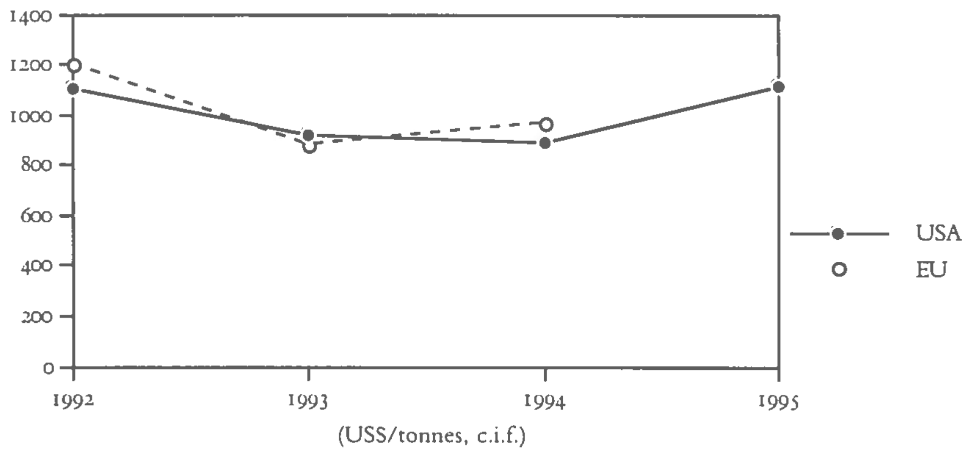

***Figure 4:** Average prices for honey imported to the USA and European Union, 1992-1995 (SUS/ton, c.i.f.).*

In many tropical countries domestic prices are high, for a variety of reasons: high tariffs or taxes, currency regulations, restriction on imports to protect local producers, distrust of imported product by consumers. These high local prices make exporting unattractive to producers; by the time freight, agents' costs and other overheads are accounted for the return to the producer is much lower than can be obtained from local sales, making it impossible for producers in these countries to export profitably at world market prices.

Volume
Honey is a bulk commodity, dominated by large importers and large exporters. Tropical countries are generally small producers and exporters, and cannot compete on the same scale as the major players.

The figures for EU imports from selected tropical countries in 1994 (Table 5) show the relative scale of countries with small export volumes and countries such as Mexico or China. It is much more difficult for a buyer to order 400 tonnes from producers in 10 different countries than to source the same volume of honey from one or two agents in a single country where there is already an active trade.

It is difficult for tropical producers to establish new markets for undifferentiated honey at world market prices.

Quality
Several quality parameters pose special challenges for exporters in tropical countries.

Table 5: *Quantities of honey imported to the European Union in 1994 from selected countries (tonnes).*

Country	Imported honey (tonnes)
Africa	
Tanzania	56
Zambia	38
Americas	
Cuba	4,501
Peru	1,771
El Salvador	1,732
Nicaragua	43
Venezuela	20
Belize	20
Mexico	24,231
Asia	
Vietnam	346
Thailand	21
Indonesia	17
China	24,394

Water content
High water content is a feature of many tropical honeys. Poor harvesting methods, especially taking unsealed combs, and exposing

honey to air after harvest are prime causes of this problem. Many tropical areas are humid, and it may be impossible for bees to ripen honey to below 20 % as a result. Some honeys are naturally high in water, such as that derived from extrafloral nectar of rubber.

The consequence of this high water content may be that the honey exceeds the legal limit for a particular market (e.g. generally not more than 21 % under Codex Alimentarius and EU standards). Honey high in water is also likely to ferment, and fermented honey is practically unsaleable in export markets.

Foreign bodies
The presence of foreign matter is a particular problem with honey from fixed-comb hives. It may come from the hive (e.g. bees, brood, pollen) or from the harvesting process (e.g. ash, smoke). Processing facilities for this type of honey are often very simple, even though there is a greater need to remove extraneous material. Excessive smoke tainting is particularly difficult to remove.

Adulteration
There is a strong temptation to adulterate honey when local prices are high and there is limited statutory checking of product. Any cases of adulterated honey would be disastrous for a developing export market, especially now that there is increasing concern about honey quality.

HMF
This chemical is used as an indicator of excessive heat and/or long storage as it naturally accumulates in honey; slowly at normal ambient temperatures and rapidly at high temperatures. The maximum level is 40 mg/kg for EU countries (except for the UK, where it is 80), though in real terms limits are generally 20 mg/kg in most EU countries (60 in the UK).

It is not difficult for honey to reach 40 C° during storage or transportation in the tropics; at this temperature honey reaches 40mg/kg in 30 days or 80 mg/kg in 50 days (White et al., 1964). Poor processing methods, involving high temperatures, will also increase HMF levels dramatically. Some tropical honeys may be naturally high in HMF, but the extent of this is largely unknown.

HMF can be an impediment to entering markets, especially the EU.

Diastase

This enzyme is also used as a quality parameter, to indicate heat 'damage' to honey; levels decrease as honey is exposed to heat. Fifty percent of diastase is destroyed in 80 days at 40 C°, or in 200 days (6.5 months) at 30 C°, or in only 5.3 hours at 70 C °(White et al., 1964).

Some honeys are naturally low in diastase to begin with such as Julbernardia (Krell et al., 1989), so that even in unprocessed honey the levels of this enzyme may be low. Diastase levels can also be an impediment to entering international markets.

OPPORTUNITIES

The limitations discussed above indicate that bulk export of honey at world market prices is not a profitable option for many tropical countries. Nevertheless, there are opportunities in the international arena if special openings or niches are found, and I will discuss two in this section.

Fair trade

Many of us have seen 'fair trade' products, especially coffee and chocolate, becoming a common sight in our supermarkets. This market segment is a rapidly growing one, and represents a real opportunity for beekeepers in some tropical countries.

Fair trade organisations give consumers an assurance that the products sold under various fair trade labels are produced according to certain ethical guidelines, typically involving a higher than average price, guaranteed payment, credit and secure contracts. Details of one such scheme are given in another paper in this volume (Harmsen, 1996), which is currently paying $US 1,550/ton f.o.b. with a premium of US$ 200/ton for certified organic honey.

From promoting honey only in the Netherlands in 1994, and only there and in Switzerland in 1995, 330 tonnes of honey was sold under the Max Havelaar/Trans Fair label in 1995. With modest growth in those markets and the addition of Germany, the volume for 1996 is expected to reach 1,100 tonnes.

Organic honey

It is a mistake to think that a tropical honey producer can increase returns by keeping bees in untouched forested areas and simply labelling the product 'organic'. Both the production and processing operations must be certified by an organisation recognised in the end market (such as the Soil Association in the UK, Naturland in Germany and the VSBLO in Switzerland).

Requirements vary between certifying bodies, but for honey they would typically include these:

- bees must forage only in organically cultivated or natural vegetation areas which have been free of pesticides for at least two years;
- there should be no conventionally farmed land within 6 km;
- the colony should not be destroyed at harvest;
- only organically produced beeswax may be used in foundation;
- no instrumental insemination is permitted;
- no artificial products may be used for feeding the bees, nor any drugs administered;
- and there are additional rules about packaging and processing.

Accreditation for organic marketing doesn't come cheaply, for instance a field visit to an African country would cost about $US7,000 (although some costs can be shared if several producers are applying), an in addition the membership fee is several hundred dollars per year and there is a levy of 1 % on sales.

However, the market has grown strongly over the past 10 to 15 years, and while no formal data are available in Europe is probably around 500 tonnes/year. Prices can be up to 50 % higher than average world prices for bulk honey. Currently demand exceeds supply.

Most organic honey being sold in Europe comes from Africa (Zambia and Tanzania) and New Zealand, with some originating in Mexico. In developed countries there are limited opportunities to produce certified organic honey because of the widespread intensification of agriculture, so supply will never fully satisfy demand.

DEVELOPMENTS IN WORLD TRADE

The world is increasingly moving towards a more liberal trading environment, and some developments in world trade have already begun to affect beekeepers in tropical and other regions (Matheson, 1995).

The General Agreement on Tariffs and Trade (better known as Gatt) has been around since 1947, trying to regulate the international economy and prevent a recurrence of the disastrous policies of the 1930s. It has changed through a succession of 'rounds' of negotiations, but the most recent set (the Uruguay round) was both long - seven years - and very radical.

Gatt has gone and in its place is the World Trade Organisation (WTO), which subsumes the functions of Gatt but goes much further in freeing up world trade. It requires member countries to remove import prohibitions and reduce import tariffs, and is also a forum for resolving trade disputes with the aim of reducing protectionism and promoting trade liberalisation.

Technical barriers

There are often good technical reasons to limit international movement of plant and animal products, particularly to prevent the movement of pests and diseases. Because importing countries can hide behind technical barriers to protect their domestic industries, the WTO has set out firm rules for technical barriers to be realistic and reasonable.

Part of the negotiations which established the WTO was an agreement on how to apply sanitary (human and animal health) and phytosanitary (plant health) measures. This is the SPS agreement, and it establishes principles which bind countries when they decide what conditions to impose on the importation of plants, animals and their products (including bees and bee products).

How does the SPS agreement work?
The agreement is a set of principles describing how importing countries should apply sanitary and phytosanitary measures, and not a technical document. The application of the SPS agreement relies on standards formulated under the auspices of international bodies such as the OIE (the world organisation for animal health).

The two main standards applicable to bee health are the OIE international animal health code: mammals, birds, bees and the OIE manual of standards for diagnostic tests and vaccines. These standards are now binding and enforceable under the WTO.

What's in the SPS agreement for bees?
The SPS agreement covers many different points, but there are some principles that are particularly relevant to world beekeeping.

Necessity
Members may apply sanitary or phytosanitary measures only where necessary, and only when supported by scientific evidence. They may not be applied in such a way as to constitute a disguised restriction on international trade.

An example of an unjustified requirement is an importing country demanding sanitary assurances for a pest or disease which is widespread within the importing country and not being officially controlled.

Equivalence
The purpose of a sanitary assurance is to ensure that a pest or disease does not establish in the importing country. In many cases there are

several ways in which this aim can be met, for example by inspection, different types of testing, treatment, or assuring that an area is pest-free.

Under the principle of equivalence an importing country cannot require an exporting country to give a specific sanitary assurance if an alternative, equivalent measure is available. This principle prevents importing countries from requiring assurances that, through their cost or level of technology, impede free trade.

Non-discrimination
An importing country must ensure that it does not require a higher level of assurance from one country than from another, without good reason.

This principle also applies to movement of bees and bee products within a country: if part of a country is substantially free from a pest and it requires sanitary assurances when importing bees or bee products from another country, the importing country must also require the same assurances and apply the same restrictions to internal movement of bees and bee products.

Risk analysis
This is at the heart of the SPS agreement; requiring the application of sound science to health protection measures. Members must ensure that all sanitary or phytosanitary measures are based on an assessment of the risks to human, animal or plant life or health, taking into account recognised risk assessment techniques.

The OIE animal health code specifies the general principles and guidelines for import risk analysis. The fundamental principal is acceptance of managed risk, rather than zero risk.

Implications for bee health
Some people might see freer movement of bees and bee products as a threat to bee health, but the SPS agreement aims for continued protection of bee health at the same time as liberalising trade. No

country will be asked to abandon a technically justified sanitary standard.

Meeting the challenge of trade liberalisation.
A resounding theme throughout the SPS agreement is that all sanitary measures must be based on sound technical evidence, and that members must implement mechanisms to ensure that all quarantine decisions are technically justified and defensible. Some countries may find this task daunting, but it is necessary to ensure that a lack of political will is not disguised as lack of skills or resources.

It has been recognised that countries do have different abilities in implementing the new principles. The least developed countries may delay full implementation for five years, and other developing countries may delay for two years where implementation is prevented by a lack of technical expertise, technical infrastructure or resources.

A bold future.
The new World Trade Organisation is open to all countries which agree to abide by the whole Uruguay round package and so far more than 100 countries have signed up, representing the major proportion of world trade. Unlike previous negotiations there is no 'á la carte' option for countries to pick and choose parts of the agreement - it must be all or nothing. There are also no 'grandfather rights' for pre-existing Gatt legislation which is inconsistent with the new principles. The clock has been set ticking for radical reform of the world trading system.

Consequences for tropical honey production.
Tropical countries which are member states will have to bring any bee health protection measures which govern the importation of bees or bee products into line with the requirements of the SPS agreement. Developing countries will have the extra two or five years mentioned above before having to fully comply with the agreement.

Tariffs are already being reduced as a result of the Uruguay round, for example the duty on honey from non-ACP countries entering the EU is being progressively lowered over the next few years.

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DISCUSSION AND CONCLUSIONS

DISCUSSION AND CONCLUSIONS

Joop Beetsma and Willem-Jan Boot

In the discussions, it was generally felt that in the Western countries, e.g. in the European Union, legislation on characteristics of honey quality is too much focussed on honey from producers in temperate zone countries. By definition, honey from perfectly capped combs and treated in the most conscientious way, should always be marketable as 'honey'. However, in many tropical countries, honey may have a high water content because of climatical reasons or nectar source, and legislation of importing countries may forbid to sell it as 'honey'. This is inappropriate and unfair but may be difficult to change because producers in Western countries have a strong lobby to defend current legislation. Moreover, it may not be worthwhile to change legislation because honey export is not really limited by legislation but by the market. For instance, water content has to be under 21 %, but the market demands a much lower water content.

In the discussion about quality characteristics of honey, it was mentioned that the water content of honey is often reduced artificially. This will not necessarily affect other characteristics like diastase activity or HMF-content much. However, it will always have negative influence on the most important characteristic: honey flavour. It was also felt that producers in tropical countries should try to establish their own quality control laboratories, because at present they often have a weak position against large honey importers. This is especially important because quality characteristics are not only used to test for e.g. overheating and adulteration, but also as a bargaining instrument.

By discussing honey export from tropical countries, it would almost be forgotten that this is not necessarily a goal. Many speakers in the Symposium have mentioned that local prices are much higher than export prices and that the local market could be developed much more. So why produce for the world market in the first place?

Beekeepers should produce honey with a quality that is preferred by the local market, which often is totally different from the quality preferred in the world market. Export of honey may be desirable because it provides a country with foreign currency, but this is a governmental goal and not a goal of private beekeepers. If export is desirable, producers in the tropics probably can sell their honey for a better price when they produce for honey with a special label, e.g. an 'ecological honey' or a 'fair trade' label.

Thus as a major conclusion of this symposium it became clear that the requirements for harvesting and management of honey differ between honey produced for the national market and that for the international market. These requirements are to a large extent determined by the consumers. This can be demonstrated with the following examples:

- Consumers in the developing countries usually use honey as a medicine. Honey is bought and used when needed. The consumer does not store the honey for a longer period. The liquid honey with a higher water content, usually sold in cleaned used bottles, offers an advantage for the consumer because it can easily be used. In case the higher water content is caused by extracting unripe honey, the advantage for the beekeeper is obvious.
- Consumers in the other countries usually use honey as a sweetener, therefore the consumption of honey per person is much higher than in developing countries. Although increasing numbers of people become aware of the medical value of honey. Both liquid and cream honey is used. Honey is bottled mainly in glass jars. The quality regulations are strictly maintained and e.g. honey with a higher water content than 21 % (clover honey 23 %) may not be sold as consumption honey.

Only a small amount of the honey produced in developing countries is exported. The quality of the honey meets the standard regulations. This honey could be sold with an ECO-certificate, because it is produced in areas where no artificial fertilizers and pesticides are used. The market for ECO-honey is growing. However, much energy has to be invested before this market will be of significance for the honey producers in developing countries. For the honey producers in developing countries it is still difficult to find these specialized honey importers. Small importers of tropical honey that is sold under an ECO-label in temperate countries are very succesful. This may serve as an example for the larger honey importers.

It is difficult to export honey that does not meet the standard regulations at a reasonable price. This problem could be solved in the following ways:

1. Instruction of beekeepers, and possibly honey hunters, concerning their harvesting methods and further management of the honey. This process can be accelerated by making agreements on differential prices according to the quality of the honey.
2. In case e.g. the water content of a honey can not be reduced in the above mentioned way, the extraction of water from honey can be considered. The prerequisite of the method is that the quality of the honey after treatment meets the standard regulations. Such a treatment should then be embodied in the FAO/WHO/EU standard regulations.
3. Another possibility is to approach the just mentioned offices to allow the export of honey from developing countries that does not meet the standard regulations. This honey should then be sold under a special label or to reconsider the standards for different types of honey.

We acknowledge the support received for the organisation of this symposium from the Directorate of International Cooperation of the Netherlands Ministry of Foreign Affairs and from the Board of Utrecht University. This enabled us to invite specialists from developing countries resulting in the special opportunity that these specialists could meet and discuss their problems with colleagues from all over the world. It was of interest to observe that honey producers from very different tropical regions are often experiencing similar problems. It has been important that these practical experiences could be discussed and we hope that this exchange of information may continue in the future.

ABOUT NECTAR

THE ASSOCIATION NECTAR

In the past 20 years, advice concerning beekeeping projects in (sub)tropical countries, initiated by Dutch institutions of development assistance or foreign institutes, was given by individual scientists working in the field of honeybee research of by few more or less experienced beekeepers. However, the number of persons who obtained experience with (sub)tropical beekeeping increased considerably during this period and the need was felt to exchange and centralise the knowledge of and expertise on beekeeping in the (sub)tropics in an association. Thus, the Netherlands Expertise Centre for Tropical Apicultural Resources (NECTAR) was founded in 1990. It is a non-governmental, non-profit association of (sub)tropical beekeeping experts in The Netherlands.

The members of NECTAR have obtained thorough working experience in several countries in Asia, Central and South America, Africa and Australia. They have worked with different bee species, e.g., the African and Western honeybee (*Apis mellifera*), the eastern honeybee (*Apis cerana*), the Africanized honeybee and stingless bees. Because NECTAR members have different backgrounds and working experiences, the association is able to advise beekeeping development organisations in the following areas: feasibility studies, proposals, funding, technical assistance and evaluation of development projects. The association has a sincere interest in the questions and problems of potential and existing individual beekeepers and groups of interested people.

The necessity for co-operation between Dutch beekeeping experts was also felt because it was frequently noticed that both Dutch and foreign institutions did not recognise the special nature of beekeeping activities. Adequate expertise was often lacking in the project proposals. For example one such proposal contained the condition that the project should become self-supporting by exporting the honey produced within five years. This is a gross overestimation of the actual possibilities, as outlined below.

When beginning in an area where a local honey market is present but where only traditional beekeeping methods are known, it will take at least five years to organise the beekeepers, even in a restricted area, and to make some progress in their management techniques. Instruction concerning more advanced beekeeping methods and the construction of improved hive types need to be repeatedly given over a period of several years. To produce honey for the world market may seem the highest goal to be reached; however, in most countries the local market is much more profitable. This is not because of the price, but also because of the quality standards of honey on the world market. To avoid disappointment of both beekeepers and financing organisation, it should be stressed that, during the initial years of a beekeeping project, little honey or any other bee product can be produced.

In addition, the local conditions of the level of technical development, the means of communication and the possibilities of transport were often not considered in the proposals. Now, due to the co-operation of NECTAR members, our association is able to assess the possibilities in a better way. We intend to carry out this advisory work in co-operation with other organisations active in this field. The aspects mentioned have been published more extensively in the quarterly magazine on technology and development, a joint publication of Agromisa, ATOL, CICAT, and TOOL: AT-source, Volume 18 (1): 11-27 (1990).

Other publications by NECTAR:

- Beetsma, J. (ed.) (1992) Bees and Forest in the Tropics.
- Kaal, J., H.H.W. Velthuis, F. Jongeleen and J. Beetsma (eds.) (1992) Traditional bee management as a basis for beekeeping development in the tropics.

Nectar has been founded in 1990. It is a non-governmental, non-profit association of tropical beekeeping experts in the Netherlands.

Nectar takes the initiative to stimulate, promote and advise on (sub)tropical beekeeping activities to interest people and organisations in development assistance programmes throughout the world. NECTAR members have working experience in Asia, Central and South America, Africa and Australia with different bee species, *Apis mellifera*, *Apis cerana*, the Africanized honey bee as well as stingless bees.

Advise and information can be obtained free of charge from:
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