Q.P. Services

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# Collecting Authentic Zambian Honey

## Background

Detecting the addition of modern syrups to honey as adulterants has proved a refractory analytical problem. These syrups can be prepared from starch enzymically. β-fructofuranosidase and α- and γ-amylases have been reported as being used in this way. Finding these enzymes in honey has been interpreted as indicating adulteration.

On the other hand, these enzymes have also been reported in some Zambian honeys, where the present investigation shows that the beekeepers do not feed bees and sugar syrups are not available.

This report describes the procedures that have been used to obtain unquestionably unadulterated honey. It also explains the steps taken to show that beekeepers do not have any access to sugar syrups and would not use them if they had.

The analytical results may not indicate the source of the enzymes but will be used to design the next phase of the investigation.

## Local Conditions

The average income in Zambia is well below the World Bank Poverty Datum Line of USD 1.90 per day. The miombo forest stretches from Angola in the west to Mozambique in the east. The beekeepers (perhaps better described as honey gatherers) providing honey to Forest Fruits Ltd live in an area of the forest in northwest Zambia covering about 50,000 hectares 900km from Lusaka. They live and work in groups, occupying two to ten huts depending on the size of the group. The forest hamlets may be close to a road or track providing vehicular access to facilitate getting the honey to the processing plant. The people are poor, essentially living at a subsistence level. For example, table sugar is not part of the diet, being too expensive. They have small plots won from the forest where they grow maize or cassava and local vegetables (including cassava leaves). They may keep chickens and, when possible, may catch bush meat.

## Beekeeping Practises and a Visit to a Beekeeper Group

A visit was made to a beekeeping group living in a small hamlet called Nyidlii in the miombo forest some distance from Mwinilunga. We then walked further into the forest to understand how log hives are used (photographs 1,2). To make the hive, the bark is removed from one of three species of tree, mpuchi, *Parinari* sp., mukungu, *Cryptosepalum* *exfoliatum* subsp. *pseudotaxus* and mwanda, *Julbernardia* sp. (only the first two occur in the area visited). The bark is cut carefully to retain the cylindrical shape. As many hives as possible are made from a single tree because it results in the death of the tree. A hive is 1.2m long and 30-45cm diameter, depending on the girth of the tree. The ends are closed with a circle of bark or a matt woven from grass. The empty hive is placed in the tree as high as possible, usually lodged between two branches, as being high up diminishes absconding. The bees make enough entrances and block up other holes with propolis. The hives are always placed away from hamlets and villages.

As they can be up to 80 km from the beekeepers' homes, hives further away are visited by making an expedition to the area, walking or cycling, and staying in the forest for a few days as necessary. The hives are without comb or foundation and left for bees to colonise. This may happen in the first or second year or not at all. About 25% of hives are productive.

It is not possible to feed the bees, so if there is a shortage of forage, the bees migrate. The impossibility of feeding the bees is shown by the impracticality of actually putting syrup in the hive or attaching and maintaining a sugar feeder on a regular basis over such extensive distances. Putting sugar feeders near the hive would make them no easier to maintain and would be liable to robbing by other animals, even if syrup were available and affordable.

The beekeepers visit the hives three to four times a year between November (wet season) and the following October (dry season). The beekeepers usually work at night, using a smoker fuelled by dry grass. They climb up to the hive with a bucket. This is less disturbing to the bees than taking the hive down and reduces absconding. One end of the hive is opened and the entire contents of the hive, including the comb except for brood comb, is cut from the hive wall, dropping the honey and comb into the bucket. Once honey has been collected from all productive hives, buckets are filled ready for taking out of the forest, holding about 25kg, the product from approximately three hives. The buckets are brought out by walking or cycling along the forest paths.

The beekeepers carry the buckets back to the hamlet. They are not allowed to keep the honey in their own huts. There is a designated Contact Beekeeper for the group who accepts the honey, recording the details in a book and stores the buckets for the group. There are 39 beekeepers in the group visited, with a total of 6,280 hives, an average of 160 each. The yield for the season just finished is 11,225 kg. Field work has shown that the average yield is about 8kg per hive. On this basis, about 1400 hives, 22% provided a harvest. This is regarded as a typical figure. The others were either un-colonised, recently colonised or not fully productive.

The distinguished authority on beekeeping, Bernhard Clauss believes there to be honeydew honeys from the miombo forest. *Marquesia* trees 'weep' in the summer during the flowering season and bees forage on the ground, both on the tree exudate and on fallen flowers.

**Sampling**

The bees generally start depositing comb at an end of the hive but sometimes away from the ends. The comb can be deposited across the diameter of the hive or from one end towards the other. A representative sample of the honey can be obtained only by removing all the honey. For example, comb at one end of the hive may have been filled from a different source of nectar than that at the other.

Thus representative sampling is best achieved from a bucket <u>provided</u> traceability from the hive to the bucket can be assured. The audit report section indicates that procedures are in place to ensure this. A mechanical limitation is the necessity to separate honey and wax. Some honey is deposited in old brood cells which have become too small for larvae.  This comb becomes very hard and difficult to extract.  Although avoided as far as possible at harvesting, some may be present.

**Audit Trail**

Buckets are re-used. Empty buckets are provided to each group of beekeepers. After the harvesting, recording the number of full buckets from each beekeeper in a book and placing all the buckets in the custody of the Contact Beekeeper as described above, a representative of the packer/exporter, Forest Fruits Ltd, is asked to come. He records the bucket weights for each beekeeper, checks for absence of brood comb and takes a refractometer reading of the honey. This information, except the latter, is recorded on Honey Bucket Storage Sheets (Appendix 1), demonstrating traceability. A document, Personal Data on Beekeepers, is also kept.

Honeys over 19% are rejected. There is provision on the sheet for a second and third delivery if there are too many buckets for transfer to the packing plant in Mwinilunga in a single trip. The representative also pays the beekeepers. Transport is arranged and four copies of a delivery note completed. One copy is left with the Contact Beekeeper, one with the field staff, a third with the receiver who supervises the intake at the factory gate and signs the copy and the fourth as the retained copy for company records. The receiver in the factory counts and weighs the buckets again and retains the records on stock cards.

The document trail for one group of beekeepers is shown in Appendices 2 and 3.

**Processing**

Processing is by batch to maintain traceability to the 300kg drum. A batch of buckets is kept overnight in a room nominally at 65°C for 20-24hours, where the honey reaches a temperature around 37°C. Alternatively, buckets are steeped in a waterbath at 50°C for four hours. Each bucket has a tag detailing the beekeeping group, the purchasing code, the identity of the beekeeper, the bucket number and the weight. These tags are used to confirm the final composition of the storage tank. The contents of each bucket are tipped on to a screen (about 20 mm mesh) and comb broken up by hand, the honey draining into a chute taking it into buckets. The wax on top of the screen still contains a lot of honey. This wax is put into a small tank with enough honey so that the Archimedes screw in the base of the tank does not become clogged. The screw takes the honey/wax mix into a large centrifuge and spun for fifteen minutes at 40Hz, using a 200 micron screen. The separated wax is removed from the screens, purified and sold. The honey is pumped up to a storage tank ready for filling into 300kg drums.

The buckets of honey from the initial screen have excess wax from the top removed for processing through the small tank mentioned above. The honey is centrifuged through a 500mm screen in a small centrifuge and transferred to the holding tank for that batch. The shift, tank number and drum number, together with the weight are recorded in a book.

The contents of the holding tank are transferred to 3 or 4 300kg drums, marked with nett, gross and tare weight and a drum code derived from the date and drum number sequence in that day's processing. In this way, the contents of any drum can be traced back to a group of beekeepers.

**Sampling from Authentic Samples**

Some samples were reported positive for β-fructofuranosidase in 2012 and others for α-amylase in 2015. The excellent traceability at Forest Fruits Ltd has meant that it has been possible to trace those samples back to at least groups of beekeepers and in some cases individuals. Honey from the crop of the season just finished has been sampled from those same groups/beekeepers. The groups and their areas are recorded on the map (Appendix 4).

It was desirable to obtain a sample as representative as possible. It was considered that as the buckets had been brought out of the forest and then brought by truck to the processing plant over rough dirt roads, the honey would be well mixed. A more meticulous mixing in the factory was impractical. Also, the requirement is to see if the sample contains a suspect enzyme and the concentration is immaterial.

Therefore the honey was tipped from the bucket through a net, to remove comb as far as possible, into a bowl. About 400g was decanted into each of three bottles. The bottles were given a unique label. I observed this process and I am satisfied that there were no errors in the way it was carried out (Photograph 3 and 4).

**Access to Syrup**

This could be produced by hydrolysis of maize or cassava. There may be other sources of starch in Zambia but none could be found. There is no factory in Zambia producing a starch-based syrup. Syrups such as Golden Syrup and molasses are available in retail packs, well beyond the financial means of subsistence beekeepers. These retail products are all imported and not available for sale in remote areas away from towns (photograph 5).

Enzymes (or acids) are not available in these remote villages for starch hydrolysis and the beekeepers and other people there have no idea how to carry out such a procedure.

There are two cane sugar factories in Zambia, Zambian Sugar Co and Consolidated Farming Ltd., selling the Kafue Sugar brand. Neither use enzymic processing to make a syrup from sugarcane.

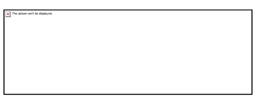
Trade statistics show that syrup is not imported. The only nearby country manufacturing syrup is South Africa. Attempts have been made to import South African/Chinese blends in retail packs but these imports are prevented by the veterinarians as the honeys do not have an import licence and they wish to keep out AFB. The Chief Veterinarian was able to state categorically that the Chinese are not attempting to become involved in Zambian beekeeping, as has apparently happened in Uganda. The smuggling of illegal syrup 2000 km from South Africa or 2000 km from the nearest international port in Namibia to northwest Zambia to sell to people too poor to buy it can safely be disregarded as a viable scenario.

A company called Bee Sweet Honey Ltd has Horst Wendorf as the company beekeeper. Horst has over 25 years' experience as a beekeeper and has been working in Zambia for the last eight. When asked if the beekeepers fed their bees or added syrup, he just burst out laughing, the idea was so ridiculous.

The bees feed off cassava put out to dry (photograph 6) and it is conceivable that the cassava contains enough of one of the suspect enzymes to give a positive result. Maize samples have also been taken from the beekeepers' hamlet for the same reason.

**Conclusion**

It is clear from economic and logistical considerations, supported by close personal observation, that sugar feeding of bees and addition of syrup to honey does not occur in Zambia. Assuming reports of positive results for β-fructofuranosidase and α-amylase are correct, these enzymes must be arising naturally. The bees do forage on cassava when this is put out to dry. They may also have access to maize meal and husk. The sampling pattern reflects previous positive results. Bee forage in the areas sampled has been recorded. The species of trees used for making the hives may be relevant. Thus it is hoped that the present sampling exercise will provide indications of origin of 'foreign' enzymes, whether from plants in the forest, the log hives themselves, honeydew honey or the bees foraging on unusual material such as cassava.



P G Martin, 28.1.16.

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Appendix 1. Honey Bucket Storage Sheet.

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Appendix 2. Delivery Note.

Appendix 3. Purchasing Sheet.

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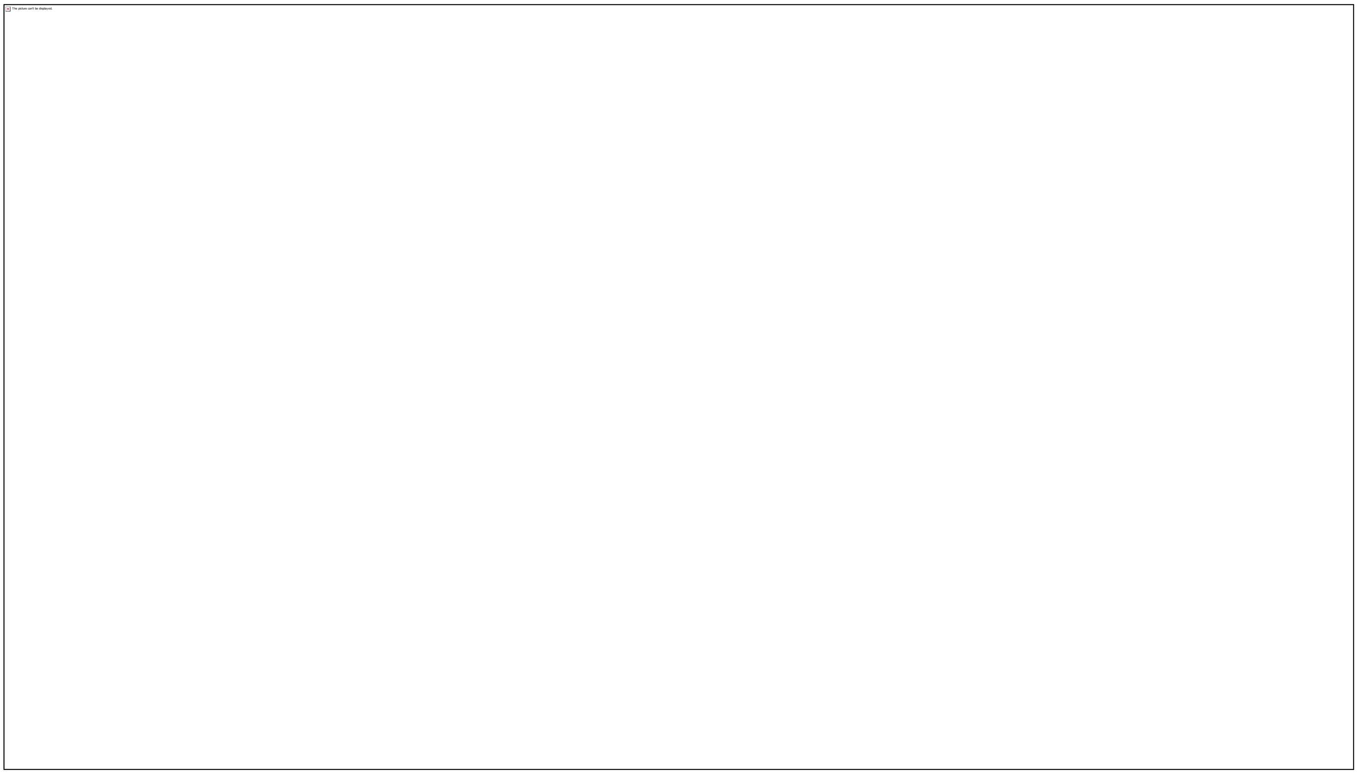
Appendix 4.  The areas sampled of the northwest Zambian miombo forest.



Photograph 1.  Log hive high in a tree.

Photograph 2.  Members of the beekeeping group with a Forest Fruits trainer.

Photograph 3.  The author sampling authenticated samples.

Photograph 4.  Authentic samples ready for shipping.

Photograph 5. Retail syrups, expensive and imported/produced only as retail packs.

Photograph 6.  Cassava drying.



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