Impact of honey harvesting and processing methods on honey quality in West Nepal

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Introduction - the district of Humla and the rationale of the study

Honey from Apis cerana cerana kept in traditional hives in remote areas of the Himalayas has potential in specialist niche markets, but lack of appropriate harvesting, processing and storage may mean that honey quality is poor. Whilst many beekeeping extension projects focus on frame or top-bar technology experiences of the authors in remote Himalayan areas and work with honey hunters in South India (Keystone 2002) suggest that simple improvements to harvesting / processing may suffice for most farmers. To date studies of Nepali honeys have been carried out (Shrestha 2000, Joshi 1999, Joshi et al 2000), but no investigations on the effect of very simple small changes in harvesting and processing upon honey quality have been attempted.

In very remote Himalayan areas such as the district of Humla in northwest Nepal where the current study is being conducted, conventional 'modern' methods of honey extraction using hand-powered centrifugal extractors prove to be inappropriate. The district ranks 4th from worst off in a composite index of development (Banskota et al 1997). Most land in Humla slopes >30 degrees & is cultivated for only one short growing season per year. Many families grow food sufficient for only 3 months per year, which means that they are too poor to invest in imported beekeeping equipment such as centrifugal extractors. Humla airport in Simikot is 10 days walk away from motor roads & only accessible in good weather. It is the main route for importing metal, glass and plastic items from the plains into Humla district, which makes these items very expensive relative to elsewhere in Nepal. The traditional hive that is predominantly in use is a fixed comb log hive (Saville and Upadhaya 2000). Adaptation of this into a log top-bar hive is appropriate to the local conditions and accepted by farmers (Saville et al 2000; Saville, Upadhaya and Acharya in press; and Saville 2000). Frame hives tend to be too expensive and need too many precise measurements to be appropriate in Humla where saws, nails, machine-cut planks and measuring tapes are not commonly used. Despite the lack of 'modern' methods of honey extraction, high altitude honey is highly valued in Nepal and has a distinctive aroma and flavour, which is preferred over other Nepali honeys. 'Cold-pressed' honey is also gaining popularity as a health product being preferable because of higher pollen levels and retention of enzymes and micronutrients (Croft 1987). This means that methods of harvesting and processing high quality honey from Humla log hives and log top-bar hives need to be promoted with farmers.

Existing traditional honey processing & storage methods have positive points. Sealed white honey is separated and kept especially for medicine, which means that high quality honey with low water content is already being separated. Honey is mashed by hand then stored in clay pots, which are sealed with a bung of Betula bark (locally called "Bhus Patra") and then plastered airtight with cow dung. Wax that comes to the surface of the honey in the pot also forms a seal. This means that the honey is stored in an airtight container and not likely to absorb water from the air or suffer from excess heat. However negative features of traditional systems also arise from lack of awareness about harvesting / processing. For example, water content may be high (> 21%), soot and dust particles are often present in high numbers and dead bees and bee parts are often found. Unsealed honey and old black combs are cooked to separate honey and wax. This spoils the honey by overheating, creating unacceptable levels of hydroxymethylfurfural (HMF) and denaturing enzymes thereby destroying honey's medicinal properties.

Methods

The current study investigates which methods of harvesting and processing, and what approaches with farmers, are appropriate to improve honey quality to the necessary standard. The main objective of HCDA's action research on honey processing in Humla is as follows.

Determine the impact of harvesting & processing on honey quality in the Karnali Zone of West Nepal by comparing:

- Traditionally harvested fresh honey
- Traditionally harvested stored honey
- Traditionally Cooked honey
- Honey harvested and processed using 'improved' methods

Samples of honeys from both Humla and Jumla districts in the different categories were compared in terms of:

- Water content
- Peroxide activity (indicating antibacterial enzyme activity)
- Qualitative indicator of HMF (Hydroxymethylfurfural)
- pH
- Reducing sugars
- Sucrose
- Electrical conductivity
- Melittopalynology
- particle content

The simple 'improved' method of honey harvesting and processing being promoted for production of 1st grade honey from both log hives and log top-bar hives is outlined as follows:

- Make sure utensils are clean and DRY (often local farmers use wet containers).
- Separate sealed, unsealed honey & bee bread (currently the bee bread is mixed with honey).
- Cut sealed honeycombs very finely (currently the combs are squeezed by hand).
- Leave the finely cut honeycombs in a sealed container out of the sun for 7 days.
- Skim off wax that comes to surface after 7 days and pour honey through a fine cloth leaving the bottom layer separate as it will have dirt, bee parts etc.
- Strain the best honey above the bottom layer through finer cloth (squeezing with clean utensils if necessary) and bottle in airtight jars with a good seal.

In addition to producing the 1st grade honey, second grade honey and other products for home consumption are also promoted using the following guidelines:

- Consume unsealed honey within 2 days and NEVER COOK ANY HONEY COMBS
- Hand squeeze skimmed wax (from the top of the settled honey) and keep this honey with the bottom layer of honey from settled out honey bucket for home use.
- Mix bee bread with a small quantity of honey from sealed combs and store in an airtight container to use as nutritional supplement. The resulting pollen honey mixture can be fed in small quantities to children, pregnant and nursing mothers, convalescent and elderly people.
- Wash all utensils and squeezed combs with clean water - this makes a delicious and medicinal drink!

Results

Thirty-three A. cerana cerana honey samples were analysed for the parameters listed above (Table 1 and Figure 1.)

Categories of honey separated by processing method	**Statistic**	**Water %**	**Peroxide activity in µg/g/hr**	**HMF in mg/Kg**	**pH**	**Reducing sugar**	**Sucrose**	**Electrical conductiv-ity US/cm**	Ranking of plant families or genera by frequency of pollen grains in 18 of the Apis cerana honey samples
Traditionally harvested & fresh Apis cerana cerana honey	Mean	18.86	17.50	< 40	4.61	70.78	3.48	33.16	1st: Compositae: (including Azaractum-, Aster-, Ageratum-, Taraxacum- and Cirsium-, types) 2nd: Labiatae, Rosaceae (incl. Malus sp.), 3rd: Zygophyllaceae, 4th: Fagopyrum sp., 5th: Poaceae, 6th: Balsaminaceae, 7th: Brassica, 8th: Curcurbitaceae, 9th: Rumex, 10th: Umbelliferae, Alnus, Loranthus, Citrus, 11th: Polygonaceae, Salix, Malvaceae, Amaranthus, Mimosaceae, PinusStarch cells found in some samples. One sample contained honeydew.
	n	18	18	18	18	18	18	11	
	SE mean	0.44	2.16		0.10	0.88	0.38	12.44	
Traditionally harvested & stored Apis cerana cerana honey	Mean	18.60	9.50	< 40	4.68	69.92	1.72	11.50	
	n	5	5	5	5	5	5	1	
	SE mean	0.78	4.87		0.15	1.86	0.24		
Cooked Apis cerana cerana honey	Mean	21.30	8.00	c. 40	4.58	69.38	3.26	14.05	
	n	5	5	5	5	5	5	4	
	SE mean	2.08	5.11		0.13	2.10	1.14	1.31	
Apis cerana cerana fresh honey from slightly improved harvesting & processing**	Mean	19.36	20.50	< 40	4.62	70.79	3.10	16.60	
	n	5	5	5	5	5	5	4	
	SE mean	1.10	5.03		0.24	2.40	0.67	4.22	

Table 1. Results of analyses of Apis cerana cerana honey from different categories of honey.

**Practical experience with traditional beekeepers showed that farmers are resistant to leaving honey to settle for several days. This may be because of a lack of spare easy-to-seal containers to leave honey to sit in and also because traditionally honey is processed and put in a safe place at the time of harvesting. This meant that only 1 out of 5 'improved' honey samples shown here used the fully improved method outlined above while the other 4 honey samples were squeezed by hand through a clean cloth.

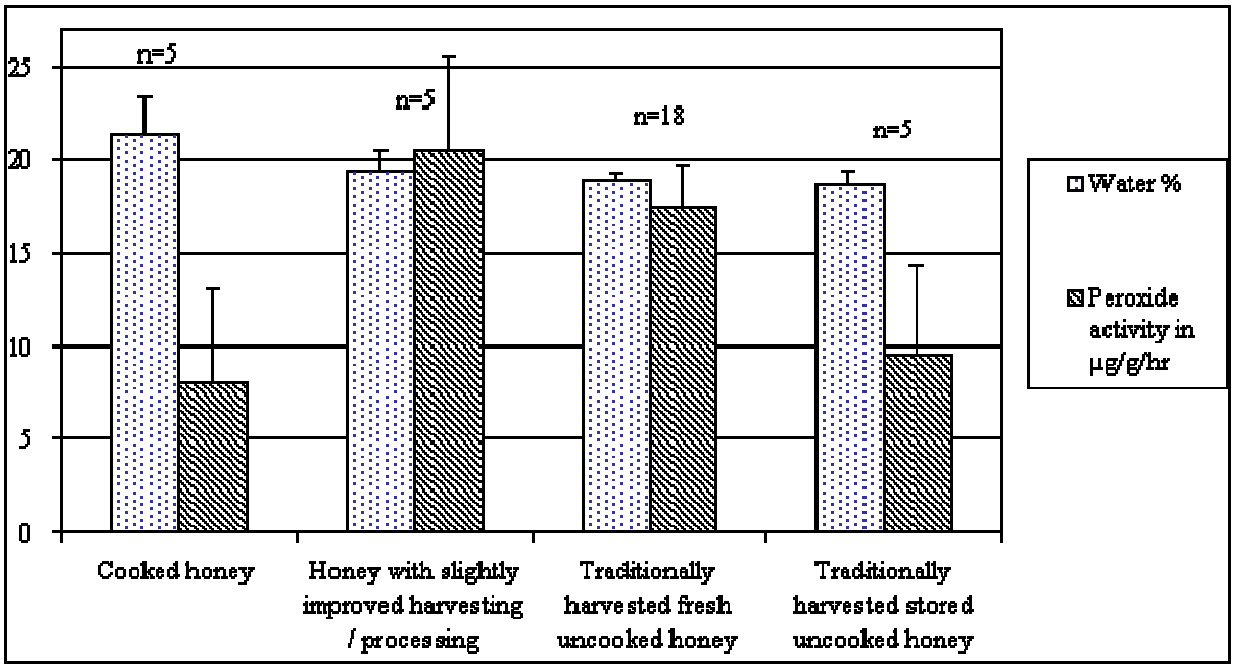

Figure 1. Water percentage and Peroxide activity of Humla & Jumla Apis cerana cerana honey samples in different categories.

Processing and storage did not affect pH, reducing sugar and sucrose levels, electrical conductivity or pollen composition. However, peroxide activity (i.e. enzyme activity of the honey) was depleted by storage and cooking, and HMF levels were increased above acceptable standards by cooking. Peroxide levels were highest in honey samples that were freshly cut from combs indicating that enzyme activity reduces as honey ages. Due to the skimming of wax from the surface and straining of liquid honey whilst hot, cooked honey was cleaner (i.e. had fewer carbon and dust particles) than uncooked, but was higher in water because water is often added during cooking. 'Improved processing' did not seem to decrease water content probably because those sorting the honey were not rigorous enough at eliminating unsealed honey comb sections from the honey to be processed. Storage did not appear to increase water content either. The traditional storage conditions (sealed clay pots) and the very low ambient humidity in the winter probably cause honey to dry out over the winter.

Observing the 5 samples processed using "slightly improved processing"; no improvement in honey cleanliness and no decrease in percentage water content could be found. However, the one sample that was processed exactly as outlined in section 2.3 was both free of carbon particles and low in water (17.8%). Whilst this finding does not provide statistically valid confirmation that the method can produce internationally acceptable honey, it encourages project staff to keep trying to persuade traditional beekeepers to use the sorting, settling and skimming method and to replicate this finding in the coming honey seasons.

Conclusions

The intention of training farmers of Humla and Jumla in the Karnali Zone of West Nepal in slightly improved honey harvesting and processing is to increase honey quality in order that farmers can get a better price by selling 'organic cold pressed honey' in specialist niche markets. A simple improved method of separating sealed and unsealed honey, cutting up sealed honeycombs, settling the honey for 7 days, skimming off the wax and then straining is suggested as an appropriate 'slightly improved method'. Preliminary findings suggest that this method could considerably improve honey quality by removing bee parts and carbon particles and keeping water content low. However, few trainers seem to be able to effectively transfer this approach so that hand squeezing of honeycombs is used instead. Such a very slight improvement in traditional methods did not significantly decrease

honey water content because the trainers did not encourage sufficient separation of sealed and unsealed honeycombs. This shows that further improvement in processing methods and more awareness raising amongst beekeepers and local trainers of the Karnali Zone is necessary.

Other findings showed that fresh uncooked honey seems to have higher peroxide activity (i.e. more antibacterial properties) than stored, cooked honey is higher in water and lower in peroxide activity than uncooked. HMF tends to be higher in cooked honey and absent in uncooked honey. Karnali honey contains a wide diversity of pollen grains, the most commonly found being Compositae, Labiatae, Rosaceae, Zygophyllaceae, Fagopyrum sp., Poaceae and Balsaminaceae.

Recommendations

The following recommendations for beekeeping extension projects in remote areas emerged from this study so far:

- Investigate existing honey harvesting and processing practices before making any intervention.
- Try improving these existing practices FIRST instead of introducing new technology at the start.
- Concentrate on market facilitation of honey from traditional hives in niche markets, rather than importing high cost technology with insufficient technical follow-up.
- Teach traditional beekeepers to feed bees so as to increase honey production, even if other bee colony management such as movable combs cannot be transferred.

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