Sensory descriptive profiling of Flow™ honey compared to honey extracted using conventional methods

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Background

The aim of this project was to determine if honey harvested using the Flow™ method was sensorily different from honeys collected using standard and commercial harvest methods. Three harvest methods (Flow™, 'backyard' and 'semi-commercial') were tested and compared in honeys collected from two separated floral sources (Yellow Pea and Macadamia). The hypothesis tested in this study is that the gentler Flow™ harvest method introduces less artefacts into the honey, thus having a positive impact on the honey sensory properties, and maintaining the original floral characteristics representing the floral source.

Sensory profiling following the principles of descriptive analysis was used to identify sensory attributes that defined and differentiated the three harvest methods for each of the floral sources.

This report summarises the findings and recommendations for further sensory studies in honey.

Materials and Method

Honey Production and Harvest

In order to reliably compare honey flavour across three different extraction methods the client aimed to harvest honey from a monofloral nectar source. To this end, bee colonies operated by a commercial honey producer were placed in two separate locations at a time of peak nectar flow from a defined floral source; either Macadamia or Pultenaea species (Yellow Flower), during September and early October 2016.

Flow™ Frame and Backyard extracted honey samples were produced in a hybrid Flow™ Super, while Semi-commercial samples were obtained from hives situated at the same sites running regular Langstroth Supers.

Flow™ Frame honey samples were collected by harvesting the Flow frames into a plastic bucket then decanting into glass jars. Backyard extracted samples were collected by removing the wax capping using a hot decapping knife and spinning the frames in a stainless steel centrifugal extractor, then filtering the honey through fine nylon mesh and decanting to glass jars. Semi-commercial honey was purchased from the commercial producer after extraction of frames from each site through his commercial extraction facility. This facility utilises a hot automatic decapper, centrifugal extractor and centrifugal wax separator. All equipment and storage in this facility is stainless steel.

Sensory profiling of honey from three harvest methods.

Honey samples

Six honey samples were provided by the client (Table 1) that represented three harvest methods – Flow frame, backyard and semi commercial - and two floral sources – Yellow pea and Macadamia.

Table 1 Detail of honey samples and volumes provided by the client

Sample	Harvest method	Floral source	Container
FF -YP	Flow frame	Yellow pea	~ 400 g x7
BY-YP	Backyard	Yellow pea	~ 400 g x8
SC -YP	Semi-commercial	Yellow pea	2kg x1
FF - MAC	Flow frame	Macadamia	~ 400 g x8
BY- MAC	Backyard	Macadamia	~ 400 g x 6 + 1 600 g
SC - MAC	Semi-commercial	Macadamia	1kg x 2

Sensory descriptive bench-top tasting

An initial bench top tasting session (1 hr) was conducted to determine if the samples were different enough to warrant sensory profiling. Seven experienced tasters (including the client) tasted the honeys under blind conditions and provided descriptors for the six honey samples. The six samples (1 table spoon) were presented at room temperature in coded 30 mL clear plastic cups, each sample was covered with a plastic lid immediately after pouring. The descriptors and comments provided by the tasters were taken into consideration in a subsequent discussion to determine if the samples warranted further sensory profiling using a trained panel. During the bench top tasting a number of observations were made:

- Samples from the Yellow Pea versus the Macadamia floral sources were distinctly different in terms of aroma.
- Differences were also observed between harvest methods within each floral source.
- Differences in colour were noticed between the harvest methods across the samples, therefore it was decided that booth sensory profiling sessions should be conducted under red light to mask the colour effect to avoid bias.
- Serving size of a teaspoon per assessor was determined to be enough to conduct the honey sensory profiling.

Sensory descriptive profiling

Conventional sensory descriptive analysis was used to profile the six honey samples. An experienced trained panel that consisted of 12 assessors (eight females and 4 males, aged between 29 and 66, with an average age of 49 years) was engaged to profiling the six honey samples over a period of three weeks. The tasting sessions comprised of ten 2-hr training sessions and two 2-hr formal evaluation sessions (see Table 2).

The samples (1-2 tsp each) were presented to panellists on white trays together with a plastic spoon served in clear 30 mL plastic cups covered with lids and labelled with a 3-digit blinding code (Figure 1). During formal evaluation sessions, fresh jars of honeys were opened for each replicate. Still and sparkling water, plain water crackers and green apple slices were provided to the assessors to cleanse the palate between samples in all sessions.

Training sessions were conducted in the focus group room and were dedicated to the development of sensory attributes and method of assessment. During vocabulary development the assessors were asked to smell and then taste each sample and then provide some descriptors for appearance, aroma, texture and mouthfeel, flavour and aftertaste. The assessors were provided with two honey aroma wheels (for example, Figure 6) to aid the description process. Toward the end of training, the samples from each floral source were separated and attributes tailored for samples from within each floral source. Discussion sessions were facilitated by the panel leader (**Error! Reference source not found.**) in which the panel reached agreement on sensory attributes definitions and reference standards for the honeys from each of the floral sources (see appendix tables 2 and 3). Unstructured line scales were developed (0-100) for each attribute and anchored from either none-high or low-high.

Figure 1 Photo of honey samples as they were presented to the panellists

Figure 2 Photo of panel training session and discussion

At the end of training, practice sessions were held to enable to panel to become comfortable with the testing conditions, to collect preliminary data and ensure that panel performance was satisfactory and to ensure the presentation protocol and method were appropriate. Practice sessions mimicked the conditions and protocol used during formal evaluation sessions.

Formal evaluation sessions were held in specialised individual sensory booths equipped with computers, red lighting to mask the colour differences (Figure 3), and under temperature control. The software Fizz version 2.5 (Biosystèmes, Couternon, France) was used for presentation design and to collect and analyse sample scores.

For each floral source a total of nine samples were scored by each panellist comprising three replications of each of the three harvest treatments. Samples were presented in sets of three with a 3 minute break between each set and an extended 10 minute break between sets to avoid fatigue.

Samples were randomly allocated within replicates and presented within each replicate according to a balanced presentation design.

Figure 3 Photo of panel formal assessment in the sensory booths under red lighting

Statistical analysis

ANOVA including a mixed model to account for the assessor and sample interaction was conducted on the sensory scores for the three samples and three replications for each of the floral sources. Paired comparison analysis on the mean intensities scores was carried out using the post hoc test analysis Fisher LSD. Assessor performance was evaluated, and the full data set of non-performing assessors, whose data did not agree with the panel average, was excluded. The assessors that had a high number of negatively correlated attributes with the panel average were excluded, taking into account that a minimum of 8 assessors were needed to be kept for each of the floral sources data set. ANOVA and paired comparison analysis was conducted using the statistical software SENPAQ software version 6 (Qi Statistics, Reading, England).

Summary of Results

Results from sensory profiling of yellow pea honey samples

Analysis of the yellow pea honey sensory scores (10 assessors) revealed that seven attributes were significantly different (ANOVA, p<0.05) across the three honey harvest methods including: *floral* aroma, *dried fruit mix* aroma, *viscosity*, *dried fruit mix* flavour (in-mouth), *cleanness*, *pungency* and *lingering* (Figure 4).

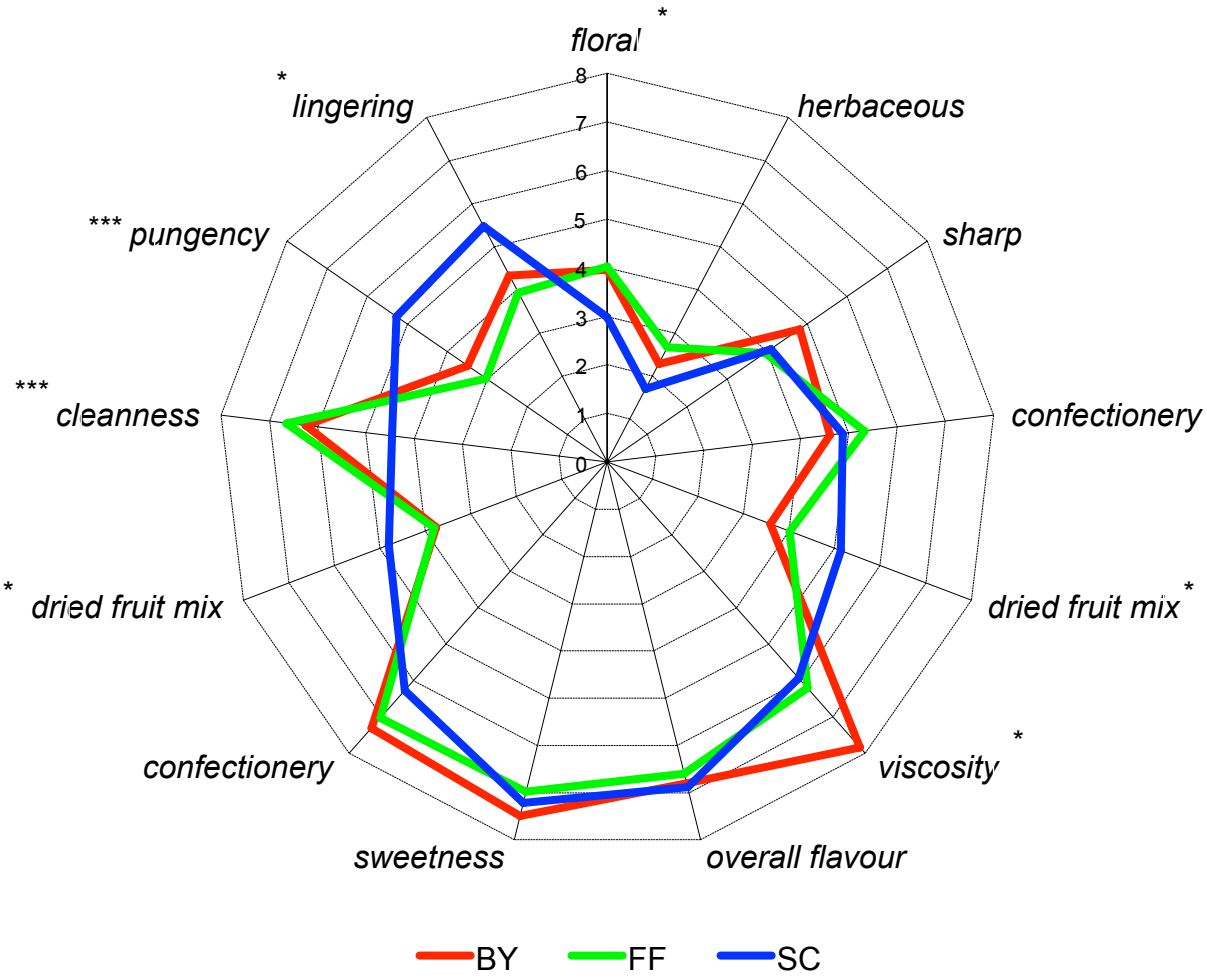

Figure 4 Spider plot of mean scores of 13 sensory attributes of yellow pea honey samples from 3 harvest methods (n=3 replicates x 10 assessors). Statistically significant differences indicated by *** (p<0.001), **(p<0.01), *(p<0.05).

The Flow™ frame (FF) harvest method samples resulted in significantly more **herbaceous** aroma than the semi-commercial (SC) sample. Flow™ frame (FF) and backyard (BY) samples were perceived as having more ***floral*** aroma, higher ***cleanness*** scores and having lower scores for ***pungency*** and ***lingering*** in aftertaste than the semi-commercial (SC) samples.

The main difference between the Flow™ frame (FF) and the backyard (BY) harvest methods was the higher ***viscosity*** of the backyard (BY) sample. The semi-commercial (SC) harvested samples were characterised by having significantly more ***dried fruit mix*** aroma and flavour and less ***confectionary*** flavour than the backyard samples (Figure 4).

Results from sensory profiling of macadamia honey samples

Analysis of the macadamia honey sensory scores (8 assessors) resulted that six sensory attributes were significantly different (ANOVA, *p<0.05*) across the three honey harvest methods including: *citrus*, *floral*, *raisin / dark toffee* aroma, *confectionary* and *raisin/ dark toffee* flavour (in-mouth) and *pungency* (Figure 5).

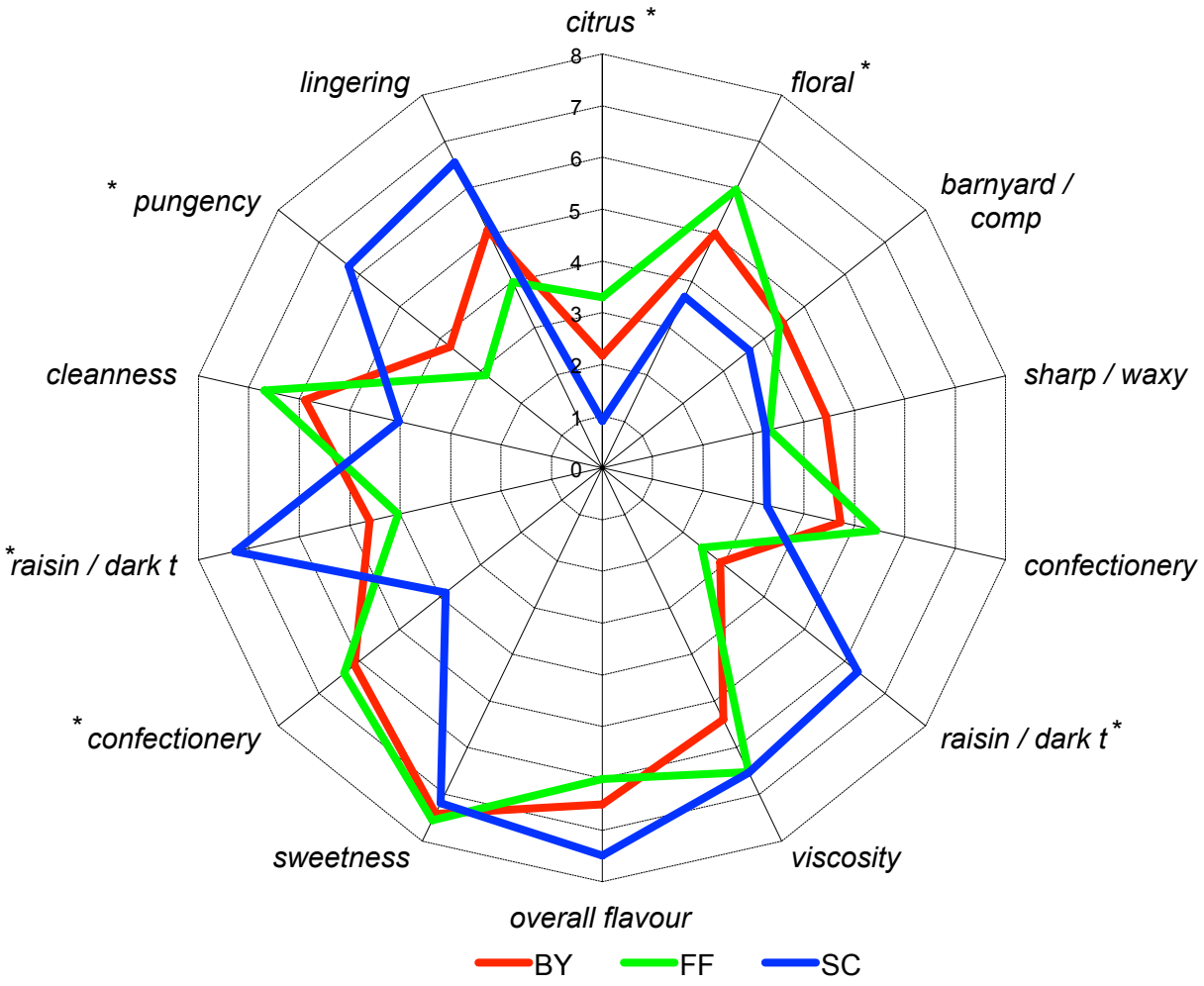

Figure 5 Spider plot of mean scores of 14 sensory attributes of macadamia honey samples from 3 harvest methods (n=3 replicates x 8 assessors). Statistically significant differences indicated by *(p<0.05).

The Flow™ frame (FF) samples had significantly higher ***citrus***, ***floral*** and ***confectionary*** flavour scores (perceived when in-mouth). The semi-commercial (SC) samples were perceived as having higher ***raisin/dark toffee*** aroma and flavour and was scores higher for ***pungency*** than the barnyard (BY) and the Flow™ frame (FF) honey harvested samples. Although not quite statistically significant, the aftertaste of the Flow™ frame samples tended to be scored higher for ***cleanness*** and lower for ***lingering*** than the semi-commercial (SC) samples.

Summary and Recommendations

Honey samples harvested at two floral sources (Yellow Pea and Macadamia) and by three harvest methods (Flow™ frame, 'backyard' and 'semi-commercial') were demonstrated to be significantly different in sensory properties using a panel of 12 assessors and conventional descriptive profiling methods.

Key findings from the sensory profiling study are summarised as follows:

- The **Flow™ frame** samples had fresher, cleaner characters than the semi-commercial samples for both floral sources.
- The fresh sensory characters in **Flow™ frame** honeys are represented by higher scores for ***floral*** aroma in both floral sources and by the higher ***herbaceous*** aroma in the yellow pea honey samples and higher scores for ***citrus*** aroma in the macadamia honey samples.
- The Flow™ frame samples from each of the floral sources also had the lowest scores for ***pungency*** and ***lingering*** aftertaste.
- The **semi-commercial** samples had more caramelised and oxidised like notes making it 'less fresh' overall in honeys from both floral sources.
- The oxidised sensory characters in the **semi-commercial** samples were represented by the higher ***pungency*** and ***lingering*** aftertaste scores in honeys from both floral sources. In the case of the Yellow pea honey samples the lack of freshness was represented by higher scores for the attribute ***dried fruit mix*** aroma and flavour, and in the macadamia honey samples by the higher scores for ***raisin/dark toffee*** aroma and flavour in the semi-commercial samples .
- The only attribute where the **backyard** and the flow frame honey harvest methods were found to be significantly different from each other, was for **viscosity** in the yellow pea honey samples. The viscosity of the backyard yellow pea honey samples was also higher than the semi-commercial honey samples.

Key observations from the sensory evaluation of the honey samples are summarised as follows:

- During training, it was clear that there was some jar-to-jar variation in terms of honey aroma.
- Honey sensory evaluation is extremely fatiguing with 9 samples per day being a maximum that could be reproducibly evaluated by any one panellist.
- In future trials, it would be recommended to budget for a larger number of training sessions than would normally be allowed for with simpler products.
- Sensory evaluation of honey is also complicated by the fact that top notes dissipate quickly and the panel described that the odour could sometimes change over time (from repeated sniffs).
- There was a clear colour difference between the samples at the time of the benchtop tasting and also during the early training sessions. The colour difference was no longer noticeable

during formal evaluation sessions. This change suggest that the samples might have been through an oxidative process post-harvest that affected the colour of the samples.

- For future sensory trials it would be recommended to provide the samples in uniform smaller container size from an initial mixed composite sample. This would allow fresh jars to be opened for each tasting session, minimize oxidation generated by the gradual increase of head space in subsequent sessions and allow more homogeneity across samples.
- While every attempt was made to remove the waxy layer from certain affected samples, this may have influenced the sensory data collected for some replicates. It is recommended for future sensory trials to avoid samples with a waxy layer (if possible).

Future recommendations and considerations:

- Floral character of honey varies depending on the nectar source. Given that Macadamia is not considered to be a really floral honey it may not have benefited from the Flow™ harvest method as other, more floral, honeys might do.
- In future studies it would be recommended to test honeys with stronger more pronounced floral characteristics.
- Given the visual oxidisation and browning of the honey over the testing period, it might be important that future studies minimise time between harvest and assessment to minimise any potential oxidative characters masking the sensorial outcome of each harvest method.
- Future studies might also be considered to determine best practice in terms of packaging, shelf-life and storage of Flow™ honey to preserve and prolong the sensorial benefits of the harvest method.

Appendices

Appendix 1 – Details of sensory attributes for the each of the floral source honeys

Table 2 Sensory attributes and reference standards agreed by the trained panel for the macadamia honey samples

Attribute	Definition	Reference standard
Aroma (none-high)		
citrus	A zesty citrus note, like orange, lime or lemon peel that disappears quickly.	Bergamot oil ½ drop (neat) plus small shaving of orange peel and small shaving of lime peel.
floral	A heady perfumed floral aroma, jasmine or rose-like).	Tiny drop of a diluted (1:100) jasmine and geranium essential oil mix (1:1)
barnyard / complexity	A complex aroma of the barnyard, a mixture of animal, fresh hay and barnyard compost.	0.1 g hay, 0.1 g compost, 0.1 dry chicken poo (Heather's garden)
sharp/waxy	A sharp note, like the lactic note of cheese and a waxy hint.	1/4 cm^2 of pecorino cheese (Auricchio Pecorino Romano, Coles deli) plus 0.2 gr unbleached beeswax
confectionery	The sweet light confectionery aroma of spun sugar, fairy floss, a very light toffee.	0.1 g fairy floss (pink vanilla, eat street market)
raisin / dark toffee	A raisin, dry fruit mix aroma with notes of burnt toffee or molasses and hints of spice.	2 dried currants with a smear of fruit mince juice (Robertsons Traditional, 410g, Fruit Mince),1/4 tea spoon propolis honey + 1/4 cm2 glaze ginger (slices, scoop and weigh deli, Coles)
In-mouth flavour and texture (low-high)		
viscosity	The viscosity or thickness of the sample in the mouth.	nil
overall flavour intensity	The overall flavour intensity of the sample.	nil
sweetness	The initial sweetness of the sample.	nil
confectionery	The sweet confectionery flavour of spun sugar, fairy floss, a very light toffee.	'as above'
raisin / dark toffee	A raisin, dry fruit mix flavour with notes of burnt toffee or molasses and hints of spice.	'as above'
Aftertaste and mouth-feel (low-high)		
cleanness	The cleanness of the aftertaste free from oxidised characters.	nil

pungency	The hot burning pungent spice sensation remaining in the mouth after swallowing.	nil
lingering	A persistent lingering sensation left in the mouth after swallowing.	nil

Table 3 Sensory attributes and reference standards agreed by the trained panel for the yellow pea honey samples

Attribute	Definition	Reference standard
Aroma (none-high)		
floral	A heady perfumed floral aroma (rose-like).	Tiny drop of a diluted (1:100) jasmine and geranium essential oil mix (1:1) plus a tiny drop of a diluted (1:20) rose essential oil
herbaceous	A herbaceous aroma like eucalyptus, mint, menthol.	Tiny drop of a diluted (1:100) eucalyptus essential oil
sharp	A sharp note, like the lactic note of cheese or barnyard and waxy.	1/6 cm^2 of pecorino cheese (Auricchio Pecorino Romano, Coles deli)+ 0.1 g hay, 0.1 g compost, 0.1 dry chicken (Heather's garden)
confectionery	The sweet confectionery aroma of spun sugar, fairy floss, a very light toffee.	0.1 g fairy floss (pink vanilla, eat street market)
dried fruit mix	A raisin, prunes, dry fruit mix, dates aroma with notes of burnt toffee or molasses. With hints of all spice, ginger and pepper	2 dried currants with a smear of fruit mince juice (Robertson's Traditional, 410g, Fruit Mince),1/4 tea spoon propolis honey + 1/4 cm2 glaze ginger (slices, scoop and weigh deli, Coles)
In-mouth flavour and texture (low-high)		
viscosity	The viscosity or thickness of the sample in the mouth when first applied to the tongue.	nil
overall flavour intensity	The overall flavour intensity of the sample.	nil
sweetness	Overall initial sweetness intensity.	nil
confectionery	The sweet confectionery flavour of spun sugar, fairy floss, a very light toffee.	'as above'
dried fruit mix	A raisin, prunes, dry fruit mix, dates flavour with notes of burnt toffee or molasses. With hints of all spice, ginger and pepper	'as above'

Aftertaste and mouth-feel (low-high)		
cleanness	The cleanness of the aftertaste free from oxidised characters.	nil
pungency	The hot burning pungent spice sensation remaining in the mouth after swallowing.	nil
lingering	A persistent lingering sensation left in the mouth after swallowing.	nil

Appendix 2 – Honey flavour wheel used during initial training sessions

Figure 6 UC Davis Honey flavour wheel - used to assist with attribute generation