APPLICATION FOR THE APPROVAL OF HONEY FROM NATIVE STINGLESS BEES AS A STANDARDISED FOOD

Australian Native Bee Association Inc.

July 2022

Application for the approval of honey from native stingless bees as a standardised food – 3rd July 2022

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EXECUTIVE SUMMARY

The Australian Native Bee Association (ANBA) seeks approval for honey produced by Australian native stingless bees to be accepted as a standardised food in Australia and New Zealand. This honey is produced by native stingless bee species in the two genera that occur in Australia, namely: *Tetragonula* and *Austroplebeia*.

Honey from Australian native stingless bees cannot currently be sold in Australia and New Zealand as it does not meet the requirements of Standard 2.8.2 – Honey. This standard regulates honey produced by the European honey bee (*Apis mellifera*).

Stingless bees are small (less than 5 mm) black social bees that in the wild live in tree hollows. Honey produced by Australian native stingless bees has been harvested from wild stingless bee populations by First Nations people and consumed as part of their normal diet for many thousands of years.

In recent decades, it has become common to keep these native bee species in artificial hives and to extract a small amount of honey (about 1kg per hive per year) that is excess to the normal requirement of the bees for their survival. This honey is a niche food product – it is valued for its rarity, and for its unique and highly regarded flavour. It is in high demand by consumers.

The safety of honey from Australian native stingless bees has been examined having regard to production and storage, composition, potential for contamination, and history of safe use. Based on these considerations, the ANBA does not consider there to be any identified public health and safety risks associated with the consumption of native bee honey.

The honey from Australian native stingless bees is composed of well characterised sugars and other natural ingredients. Nutritionally, it is similar to honey produced by *Apis mellifera*. The low volume of honey produced by stingless bees means the level of consumption will always be low compared to the consumption of honey produced by *Apis mellifera*. It will, however, provide an additional source of naturally occurring sugars with minimal nutritional impact for consumers.

The purpose of this application is to have honey from Australian native stingless bees approved as a standardised food in Australia and New Zealand. To this end, the application seeks:

- To have a separate definition for honey produced by native stingless bees.
- To have a separate compositional requirement for honey produced by native stingless bees.
- To make the term 'native bee honey' a prescribed name.

This will require a variation to Part 2.8 – *Sugars and Hon*ey as well as a variation to Part 1.2 – *Labelling and other information requirements*.

The ANBA proposes that a separate definition and compositional requirement for honey from Australian native stingless bees be established. This will clearly separate this honey from honey produced by *Apis mellifera* that is currently defined in Standard 2.8.2.

The ANBA also proposes that the term 'native bee honey' be a prescribed name to firstly, assist allergy-sensitive individuals who may wish to avoid foods containing honey due to the potential presence of small quantities of pollen and/or propolis and, secondly, to assist consumers to make an informed choice between this food product and honey produced by *Apis mellifera,* and to prevent misleading and deceptive conduct.

The ANBA will provide addition information to consumers to assist them to become more familiar with the honey from Australian native stingless bees as a new standardised food.

This application addresses all the requirements necessary to approve the honey from Australian native stingless bees as a standardised food in Australia and New Zealand.

GENERAL REQUIREMENTS

The following general information is provided in accordance with Part 3 – Application Guidelines of the Food Standards Australia New Zealand *Application Handbook* FSANZ (2019).

A. Form of the application

The application is presented according to Section 3.1.1 – General Requirements.

B. Applicant details

Contact details of applicant and organisation

[redacted]

Nature of organisation

The Australian Native Bee Association (ANBA) promotes the conservation and sustainable use of all Australian bees. ANBA achieves that by providing resources, disseminating information, supporting members, and communicating with stakeholders.

More information on the Australian Native Bee Association is provided in **Appendix 3**.

Details of other parties involved with the application

The following members of the Australian Native Bee Association were on the sub-committee for preparation, submission, and stewardship of this application:

[redacted]

C. Purpose of the application

In Australia, honey from native bees is the product of the social bee species in the genera *Tetragonula* and *Austroplebeia*, referred to variously as stingless bees, social native bees, sugarbag bees, sweat bees or bush bees. Further information on social native stingless bees and their management is presented in **Appendix 4**.

Native stingless bees live in tree hollows in the wild but can also be kept in small artificial hives. Honey that is excess to the requirements of the bees can be harvested from these artificial hives. Further information on harvesting methods for honey from native stingless bees is presented in **Appendix 6.**

The purpose of the application is to have honey from Australian native stingless bees approved as a standardised food in Australia and New Zealand.

To this end, the application seeks:

- To have a separate definition of honey produced by native stingless bees.
- To have a separate compositional requirement for honey produced by native stingless bees.
- To make the term 'native bee honey' a prescribed name.

A separate definition and compositional requirement for honey produced by native stingless bees will require a variation to Part 2.8 – *Sugars and Hon*ey.

This will require a variation to Part 2.8 – *Sugars and Hon*ey as well as a variation to Part 1.2 – *Labelling and other information requirements*.

The ANBA proposes that a separate definition and compositional requirement for honey from Australian native stingless bees be established by creating a new standard in Part 2.8 – *Sugars and Honey* that specifically permits honey produced by native stingless bees and recognizes it as a different food to honey produced by *Apis mellifera*.

A prescribed name of 'native bee honey' will require a variation to Part 1.2 – *Labelling and other information requirements*, and more specifically, Standard 1.2.2 – Food Identification.

The reasons for requesting that the term 'native bee honey' be a prescribed name are firstly, to assist allergy-sensitive individuals who may wish to avoid foods containing honey due to the potential presence of small quantities of pollen and/or propolis, thus, protecting the public health and safety of this segment of the community (1st objective in section 18 of the FSANZ Act); and secondly, to link it with the definition and compositional requirements for native bee honey, thus providing adequate information for consumers to make informed choices (2nd objective in section 18 of the FSANZ Act), and to prevent misleading and deceptive conduct (3rd objective in section 18 of the FSANZ Act).

The Australian Native Bee Association surveyed its membership in July 2021 to determine the preferred name for honey produced by native stingless bees. The poll revealed a clear preference for the name "Native Bee Honey".

D. Justification for the application

The application for approval of honey from native stingless bees as a standardised food is based, firstly, on the increasing availability and public demand for honey from this source and, secondly on the premise that honey from this source does not currently meet the requirements of Standard 2.8.2 – *Honey*.

Native stingless bee honey has a very long history of use as a food by the First Nations people of Australia, and a more recent history of use by European settlers. The modern practice of keeping stingless bees in artificial hives has made the honey from stingless bees more available to the Australian public. According to surveys conducted by the ANBA in 1998, 2010 and 2020, the number of people keeping hives of native stingless bees has continued to increase over recent decades, and hence the supply of honey from native stingless bees has increased accordingly. The popularly of this honey is such that the public demand is significantly greater than the current supply. Further information on the historical use of stingless bee honey and the current interest in keeping stingless bees is provided in **Appendix 5**.

While the use of stingless bees for crop pollination is growing significantly and is now at a commercial level, the production of honey from stingless bees remains at a largely cottage industry level due to the uncertainty regarding the regulatory status of the honey. There is potential for a significant growth in production and sale of native stingless bee honey if it is recognised and regulated as a standardised food.

The current Standard 2.8.2 – *Honey* contains two matters that are seen to prevent honey from Australian native stingless bees being regarded as a standardised food in Australia.

Firstly, the Standard has the following definition for honey:

> ***Honey*** means the natural sweet substance produced by honey bees from the nectar of blossoms or from secretions of living parts of plants or excretions of plant sucking insects on the living parts of plants, which honey bees collect, transform and combine with specific substances of their own, store and leave in the honey comb to ripen and mature.

This definition refers to honey as being produced by honey bees. The term 'honey bee' generally refers to the European honey bee, *Apis mellifera*, according to both the Macquarie Dictionary and the Australian Concise Oxford Dictionary. The common interpretation, therefore, is that honey is the product of *Apis mellifera* only.

Secondly, the Standard has the following requirement for food that is sold as 'honey':

> A food that is sold as 'honey' must:
>
> (a) be honey; and
>
> (b) contain:
>
> (i) no less than 60% reducing sugars; and
>
> (ii) no more than 21% moisture.

The honey produced by native stingless bees does not meet the above definition of honey as it is not produced by honeybees (*Apis mellifera).* It also does not meet the compositional requirements of 'honey' in Standard 2.8.2. Honey produced by the native *Tetragonula* species does contain 60% or more reducing sugars but can also contain more than 21% moisture. Honey produced by the native *Austroplebeia* species usually contains less than 21% moisture but can also contain less than 60% reducing sugars.

The application is justified based on the increased availability and demand for honey from stingless bees and the need to ensure that the honey:

(i) is safe for consumers; and

(ii) is clearly labelled to ensure consumers can make an informed choice; and

(iii) is clearly identifiable to prevent misleading and deceptive practices.

D1 Regulatory Impact Information

D1.1 Cost and benefits of the application

1. Consumers

There is a growing interest in keeping native stingless bees in artificial hives and in the harvesting of honey from native bees. Currently this honey is only available commercially on a small scale due to limited availability and regulatory uncertainty. However, the honey that is harvested by small scale native beekeepers is readily consumed by the public who have shown a keen interest in the limited supplies available. Honey from native stingless bees has a unique flavour profile imparted by its high acidity and the presence of low levels of plant resins. Approval of this application would allow greater community access to this special and highly regarded food through retail suppliers.

As a niche food product, the honey from native stingless bees would be sold at a premium price. Approval of this application would result in an expansion of this growing industry by providing a clear regulatory framework and provide consumers further access to this food product. It would also assist consumers to make an informed choice based on clear labelling of the food product.

There are significant benefits and no costs to consumers associated with the application.

2. Producers and retailers

Approval of this application would allow the honey from Australian native stingless bees to be marketed within a clear regulatory framework, leading to improved opportunities for both producers and retailers.

Many native stingless beekeepers provide pollination services for agricultural and horticultural crops. The growing interest in the use of native stingless bees for pollination services has resulted in significant expansion in the number of native stingless beehives used for this purpose. The diversification of income provided by the sale of honey from Australian native stingless bees will help the stingless bee industry to grow further, with an expansion of pollination services and production of honey from native bees.

There are significant benefits and no costs to producers and retailers associated with this application apart from those associated with labelling and marketing.

D1.2 Impact on international trade

There is currently no international trade in honey from Australian native stingless bees. We expect that the industry will grow domestically for a considerable period before production will be sufficient to supply international markets. At that stage, a standard for honey from Australian native stingless bees would only benefit efforts to market overseas.

E. Information to support the application

As stated in section C. Purpose of the Application, this application to have honey from Australian native stingless bees approved as a standardised food in Australia and New Zealand will require an amendment to Part 2.8 – *Sugars and honey* as well as an amendment to Part 1.2 – *Labelling and other information requirements*.

The application is therefore prepared pursuant to Chapter 3.6 – *Guidelines for applications for special purpose foods and standardised foods* and to *Chapter 3.2 – Guidelines for applications for labelling and other information requirements* of the *Application Handbook* (FSANZ, 2019).

The data required to support the proposed changes to Part 2.8 and Part 1.2 of the Food Standards Code are presented in the appropriate sections below according to the requirements of Chapter 3.2 and Chapter 3.6 of the Application Handbook (FSANZ, 2019). In some cases, additional information is provided in the Appendices.

F. Assessment procedure

The honey from Australian native stingless bees is a natural substance consisting of simple sugars and has been consumed in Australia by our First Nations people for many thousands of years. There are also anecdotal newspaper reports of consumption by European settlers from at least 1803 (see **Appendix 5** for further information and references to support these statements). More recently, consumption has increased following the development of artificial hives to keep native bees. There is no evidence that consumption of this honey raises any public health and safety concerns, and the application applies to only one food type. Therefore, the Australian Native Bee Association considers that the most appropriate assessment procedure for this application is the **General Procedure**.

G. Confidential commercial information (CCI)

The application does not contain any Confidential Commercial Information.

H. Other confidential information

The application does not contain any other confidential information.

I. Exclusive capturable commercial benefit (ECCB)

The honey from Australian native stingless bees is currently produced largely by amateur beekeepers, but there is considerable interest in commercialising production of honey from native stingless bees. The marketing and sale of honey from native bees will be the responsibility of these commercial beekeepers. The Australian Native Bee Association is applying on behalf of these beekeepers but will not receive any financial benefit resulting from the approval of this application. On this basis, this application would not confer any Exclusive Capturable Commercial Benefit (ECCB) to the Australian Native Bee Association in accordance with Section 8 of the FSANZ Act with which states:

> An exclusive, capturable commercial benefit is conferred upon a person who applies for the development of a food regulatory measure or the variation of food regulatory measure under Section 22 if:
>
> (a) the applicant can be identified as a person or body that may derive a financial gain from the coming into effect of the draft standard to draft variation of the standard that would be prepared in relation to the

application; and

(b) any other unrelated persons or bodies, including unrelated commercial entities, would require the agreement of the applicant in order to benefit financially from the approval of the application

As such, the Australian Native Bee Association requests exemption from any costs of processing this application.

J. International and other national standards

J.1 International standards

There are no Codex Alimentarius Commission (Codex) Standards relevant to this application.

J.2 Other national standards or regulations

Malaysian Standard MS 2683:2017 *Kelulut* (Stingless bee) honey – Specification (Department of Standards, Malaysia 2017)

Normative Instruction No 001. Espirito Santo, Brazil: Agriculture and Forestry Defense Institute 2019.

These national standards refer to honey produced by different stingless bee species and are not relevant to this application. They do, however, demonstrate that Australia is not the only country to consider regulations for honey produced by stingless bees.

K. Statutory declaration

A signed Statutory Declaration for Australia is provided in **Appendix 1.**

L. Checklist

A completed checklist relating to the information required for this application is provided in **Appendix 2.**

References

Malaysian Standard MS 2683:2017 *Kelulut* (Stingless bee) honey – Specification (Department of Standards, Malaysia 2017)

Normative Instruction No 001. Espirito Santo, Brazil: Agriculture and Forestry Defense Institute 2019.

GUIDELINE 3.6.1 STANDARDISED FOODS

A. General Information to support the proposed compositional change

A.1 A description of the nature of the proposed compositional change

This application to approve honey from native stingless bees does not propose any change to the existing composition requirements for honey from *Apis mellifera* as currently described in Standard 2.8.2, but rather to include a new definition and compositional requirements for honey from native stingless bees.

The information below is provided to demonstrate that while honey from native stingless bees shares many compositional similarities with honey from *Apis mellifera*, it differs in some physicochemical properties and in its sugar spectrum.

The composition of honey from Australian native stingless bees has been shown to be broadly consistent with widely consumed honey from other species of stingless bees found in tropical and subtropical parts of the world (Souza et al., 2006; Nordin et al., 2018). Species-dependent differences, however, do not allow a direct comparison.

Physicochemical properties of stingless bee honey

Honey from stingless bees possesses several physicochemical properties that are distinctly different from honey produced by the honeybee *Apis mellifera*, namely, electrical conductivity, free acidity, moisture content, and water activity.

Table 1 below provides a summary of the physicochemical parameters of honey produced by the Australian *Tetragonula* and *Austroplebeia* species and compares this data with the Codex Alimentarius specifications for honey (CODEX standard 12, 2001) and with the requirements of Standard 2.8.2. The detailed data and references from individual studies is provided in **Appendix 7**.

Table 1. Comparison of physicochemical parameter results for native bee honey with Codex and FSC Standard 2.8.2 requirements

Parameter	***Apis mellifera* honey requirements**		**Native bee honey Results**	
	Codex specifications	**Standard 2.8.2**	***T. carbonaria*** A. Persano Oddo et al, 2008 B. Haley & Heard, 2021	**A. australis** Haley & Heard, 2021
Moisture %	<20	<21	25.3 – 27.5 (A) 24.4 – 31.8 (B)	17.4 – 22.0
Electrical conductivity (mS/cm)	Maximum 0.8 *	N/A	1.3 – 1.7 (A)	unknown
Free Acidity (mEq/kg)	Maximum 50 *	N/A	94 – 156 (A) 29.4 – 143.8 (B)	8.6 – 51.9
HMF (mg/kg)	<80 * (Tropical regions)	N/A	0.4 – 2.1 (A) 0.1 – 14.3 (B)	0 - 14
Diastase (Schade units)	>8 *	N/A	0.1 – 1.7 (A) 0.0 – 0.3 (B)	0 – 1.1
pH	N/A	N/A	3.9 – 4.2 (A) 3.5 – 4.7 (B)	3.8 – 6.4

Note: Codex Alimentarius specifications noted with an * are optional, and "intended for voluntary application by commercial partners, and not for application by governments".

Recent studies (Zawawi et al., 2022) on honey from *Tetragonula carbonaria* and *Tetragonula hockingsi* has confirmed the data for % moisture, pH and free acid for *Tetragonula carbonaria* and provided new data for *Tetragonula hockingsi*. This data is provided in the Table 2 below.

Table 2. Further physicochemical parameter results for honey produced by *Tetragonula carbonaria* and *Tetragonula hockingsi*

	***Honey produced by Tetragonula carbonaria* (n = 11)**		***Honey produced by Tetragonula hockingsi* (n = 10)**	
Parameter	**Average**	**Range**	**Average**	**Range**
Moisture (%)	25.48	23.91-26.88	25.15	23.75-27.66
pH	3.6	3.5-3.71	3.63	3.44-3.88
Free Acid (meq/kg)	167.8	98.5-212.3	125.4	74.1-202.0

In relation to the electrical conductivity (reflecting the mineral content) and the free acidity (reflecting fermentation of sugars into organic acids), these may influence the taste of the honey, but raise no safety concerns. Consequently, there is no reason to include these parameters in the compositional requirements for honey produced by native bees.

In relation to moisture content, honey from Australian native stingless bees can have a moisture content of more than 21% depending on the native bee species from which the honey is derived. Recent data on honey from *Austroplebeia australis* (Haley & Heard, 2021) indicates the moisture content is usually less than 21%. Honey from *Tetragonula* species, however, usually has a moisture content higher than 21%. Therefore, the compositional definition of honey from Australian native stingless bees needs to allow for a higher moisture content than the 21% allowed for honey produced by *Apis mellifera.* In the paper by Persano Oddo (Persano Oddo *et al.,* 2008) and the paper by Zawawi *(*Zawawi *et al., 2022)*, the moisture content of honey from Australian native stingless bees does not exceed 28%. This seems to be an appropriate figure to use in a compositional definition of honey produced by Australian native stingless bees.

In relation to water activity, honey from Australian native stingless bees has a water activity of 0.74 which is higher than the water activity of honey produced by *Apis mellifera*, which is reported in the range of 0.49-0.63 (Cavia *et al.,* 2004). The potential for fermentation of honey from Australian native stingless bees when kept at room temperature is therefore higher than for honey produced by *Apis mellifera*. There are no public health and safety issues associated with slight fermentation.

The effect of storage temperature on physicochemical parameters was examined in honey produced by both *Tetragonula* species and by *Austroplebeia* species (Haley & Heard, 2021), as shown in the Tables 3 and 4 below.

Table 3. Effect of storage temperature on the physicochemical parameter results for honey produced by *Tetragonula* species

***Tetragonula* species**				
Refrigerated temperature storage 2 to 22 months post harvest				**Room temperature storage 19 months post harvest**
Parameter	**Average (n = 6)**	**Standard Deviation**	**Range**	**Result (n = 1)**
Moisture (%)	26.4	2.9	24.4 – 31.8	27
pH	4.0	0.4	3.5 – 4.7	3.5
Free Acid (meq/kg)	87.5	39.8	29.4 – 143.8	291.9
HMF (mg/kg)	3.0	5.6	0.1– 14.3	79.6
Diastase	0.1	0.1	0.0 - 0.3	0

Table 4. Effect of storage temperature on the physicochemical parameter results for honey produced by *Austroplebeia* species

***Austroplebeia* species**				
Refrigerated temperature storage 1 to 10 months post harvest				**Room temperature storage 22 months post harvest**
Parameter	**Average (n = 13)**	**Standard Deviation**	**Range**	**Result (n = 1)**
Moisture (%)	19.9	1.2	17.4 – 22.0	20
pH	4.6	0.7	3.8 – 6.4	3.9
Free Acid (meq/kg)	27.2	16.4	8.6 – 60.0	51.3
HMF (mg/kg)	3.7	4.9	0.0 – 14.1	142.9
Diastase	0.2	0.4	0.0 – 1.1	0

Both free acid and HMF levels increased in native bee honey stored at room temperature compared with the levels in honey stored at refrigerated temperature, reflecting more extensive fermentation of sugars into organic acids at room temperature.

While free acidity is used as a quality indicator in *Apis mellifera* honey to detect undesirable fermentation, in native bee honey, fermentation is an accepted feature of the honey, so the higher free acidity values do not raise any quality concerns.

HMF (hydroxymethylfurfural) is formed by the breakdown of sugars in the presence of an acid. Native bee honey stored at refrigerated temperatures has lower values of HMF than honey stored at room temperature as a result of a slower breakdown of sugars at refrigerated temperatures. HMF levels are naturally high in many common foods including coffee, baked cookies, and dried fruit (Shapla et al., 2018).

Further discussion of the storage stability of honey from Australian native stingless bees and preservation techniques that will decrease the likelihood of fermentation is provided in **Appendix 10.** The implications for the labelling of native bee honey are discussed below in Section A.1 under Guideline 3.2.4.

Sugar spectrum of stingless bee honey

Honey from stingless bees also has a sugar spectrum that is somewhat different to that of honey produced by *Apis mellifera*, particularly in relation to fructose and glucose, and in relation to the presence of the uncommon disaccharide trehalulose.

Honey from *Tetragonula* species

Honey produced by *T. carbonaria* is a good source of energy provided by the sugars, fructose and glucose, although the fructose and glucose levels are lower than those in *Apis* honey.

Honey from both *T. carbonaria* and *T. hockingsi* also contains high levels of an uncommon disaccharide, trehalulose (Fletcher et al., 2020). This disaccharide has been previously found in stingless bee honey but incorrectly reported as maltose (Persano Oddo et al., 2008). Trehalulose is an isomer of sucrose with an unusual α-(1→1) glucose-fructose glycosidic linkage. It has previously been reported as a very minor sugar in some *Apis* honeys (Sanz et al., 2004; de la Fuenti et al., 2011).

Recent studies supported by the Australian Native Bee Association have examined the biological origin of trehalulose, as well as the environmental factors that influence the production of this disaccharide. The results of these studies have shown that stingless bees fed sucrose in experimental hives produced honey rich in trehalulose. When sucrose was absent from the diet, bees produced honey containing no trehalulose (Fletcher, Hungerford, and Smith, 2021).

Honey from *Austroplebeia australis*

Honey produced by *Austroplebeia australis* has higher levels of fructose and the lower levels of trehalulose than the honey produced by *T. carbonaria*, but the total sugar content is similar. The sucrose level in honey from *A. australis* is higher than that found in honey from *T. carbonaria,* consistent with lower levels of trehalulose conversion from sucrose in *A. australis.*

Tables 5 and 6 below provide a summary of the sugar spectrum of honey produced by *Tetragonula carbonaria* and *Austroplebeia australis* based on the studies conducted by Persano Oddo (Persano Oddo et al., 2008) and by Haley & Heard (Haley & Heard, 2021).

Detailed data and references to individual studies are provided in **Appendix 8**.

Table 5. Sugar spectrum of honey produced by *Tetragonula carbonaria* and *Austroplebeia australis*

Parameter	Honey produced by *Tetragonula carbonaria*		Honey produced by *Austroplebeia australis*	
	Average (n = 8)	Range	Average (n = 10)	Range
Fructose (g/100g)	24.5	21.8-27.4	33.1	29.9 – 36.1
Glucose (g/100g)	17.5	14.3-22.7	19.4	14.5 – 24.0
Sucrose (g/100g)	1.8	0.9-2.2	6.0	0.0 – 13.0
Trehalulose (g/100g)*	20.3	15.3-22.8	3.7	2.7 – 4.9
Reducing sugars (g/100g)**	62.3	-	59.0	55.3 – 61.6
Total sugar (g/100g)	64.1	60.5-66.3	65.0	61.5 – 68.4

*Reported as maltose, but subsequently identified as trehalulose (Fletcher et al., 2020)
** Estimated by adding the values for glucose, fructose, and maltose (trehalulose)

Recent studies by Zawawi (Zawawi et al., 2022) on honey from *Tetragonula carbonaria* and *Tetragonula hockingsi* has confirmed the data for the sugar spectrum for *Tetragonula carbonaria* and provided new data for *Tetragonula hockingsi*. This data is provided in the table below.

Table 6. Sugar spectrum of honey produced by *Tetragonula carbonaria* and *Tetragonula hockingsi*

Parameter	Honey produced by *Tetragonula carbonaria* *n = 11*		Honey produced by *Tetragonula hockingsi* n = 10	
	Average	Range	Average	Range
Fructose (g/100g)	17.43	12.98-22.4	16.58	10.48-20.60
Glucose (g/100g)	12.10	7.81-15.26	12.71	6.39-16.91
Sucrose (g/100g)	ND*	ND	ND	ND
Trehalulose (g/100g)	23.18	18.03-35.45	24.90	18.62-38.75

*ND = not detected

Honey from native bees generally has a lower fructose and glucose content than honey produced by *Apis mellifera*, as shown in Table 7 below, however, fructose and glucose levels in all honey are highly dependent on the floral source (De Melo *et al.*, 2017).

In an analysis of carbohydrate composition of Spanish unifloral honeys, (De la Fuente et al., 2011) reported trehalulose levels up to 3.3g/100g.

Table 7. Sugar spectrum of honey produced by *Apis mellifera*

Parameter	Honey produced by Apis mellifera
	Range
Fructose (g/100g)	32-44
Glucose (g/100g)	23-38
Sucrose (g/100g)	1
Trehalulose (g/100g)	0-3.3
Reducing sugars (g/100g)	>60

In the studies conducted to examine the biological origin of trehalulose (Fletcher, Hungerford and Smith, 2021), further data was collected on trehalulose levels in native bee species occupying hives in a variety of different habitats in order to examine the influence of habitat on trehalulose levels. In these studies, trehalulose levels were examined in honey taken in some cases from individual honey pots within each hive as well as from the combined honey from each hive. The levels of trehalulose showed wide variation depending on the floral sources in the local habitat and the sucrose content of the floral sources. The trehalulose levels in individual honey pots therefore will be highly variable and, in some cases, may contain no trehalulose if that particular honey pot is filled from a floral source low in sucrose. The higher levels of trehalulose in honey produced by *Tetragonula* species compared with honey produced by *Austroplebeia* species may reflect their differing floral preferences as well as their different digestive abilities.

Table 8 below is taken from the paper by Fletcher et al (Fletcher, Hungerford and Smith, 2021). It contains a summary of all the collected data from these studies described above, including the trehalulose data from individual honey pots within a hive, hence the range of trehalulose levels reported starts at zero, for the reason stated above. Honey collected from a native beehive will be from the sum of all of the honey pots in that hive, hence the trehalulose levels will be reflected by the figures for the average trehalulose content, which are consistent with the average trehalulose level reported in other studies reported above.

The presence of significant levels of trehalulose in native bee honey compared to honey from *Apis mellifera* provides an opportunity to use this difference as a defining characteristic of native bee honey. While the levels of trehalulose vary between the honey from *Tetragonula* and *Austroplebeia* species and the levels are also dependent on the local floral habitat, the trehalulose levels in all native bee honey remain consistently above 2% and, in most cases, significantly higher.

The definition of native bee honey is discussed below and the inclusion of a minimum level of 2% trehalulose is proposed. While it is not essential to include a minimum of 2% trehalulose in a definition of native bee honey, it provides an additional and directly measurable factor to distinguish native bee honey from honey produced by *Apis mellifera*.

Table 8. Sugar spectrum of honey produced by *Tetragonula* and *Austroplebeia* species

Sugar	***Tetragonula***			***Austroplebeia***		
	Average (*n* = 89)	**Standard Deviation**	**Range**	**Average (*n* = 22)**	**Standard Deviation**	**Range**
Fructose (g/100g)	18.8	8.8	0.0 – 39.7	30.5	5.8	13.9 – 37.1
Glucose (g/100g)	11.9	8.4	0.0 – 3.5	17.1	5.5	0.0 – 22.7

Maltose (g/100g)	0.09	0.37	0.0 – 3.5	ND		
Sucrose (g/100g)	ND			2.1	3.0	0.0 – 10.1
Trehalulose (g/100g)	18.5	11.6	0.0 – 48.7	4.5	3.7	0.0 – 15.0

<u>Reducing sugar in honey</u>

The total reducing sugar content for honey from *Tetragonula* species is similar to that of honey from *Apis mellifera*, namely, greater than 60% reducing sugars, however, the honey produced by *Austroplebeia australis* can be as low as 55% (see Table 1 above). Therefore, the compositional definition of honey from native stingless bees in this regard will need to be different to that for honey produced by *Apis mellifera*. It is proposed that a reducing sugar limit of no less than 50% be established to account for variation in batches.

Proposed definition and composition of stingless bee honey

Based on the information above, the composition requirements for honey from Australian native stingless bees need to differ from the requirements for honey from *Apis mellifera* in relation to both the moisture content (which should be limited to 28% in native bee honey) and the lower limit of reducing sugars (no less than 50% in native bee honey).

It is also proposed that a minimum level of 2% trehalulose be included in compositional requirements for native bee honey. This would provide a directly measurable marker for native bee honey and prevent misleading and deceptive conduct in relation to the sale of native bee honey.

This compositional definition for honey from native stingless bees will more accurately reflect the true nature of the food.

If a new standard in Part 2.8 is required for honey from Australian native stingless bees, the following paragraphs are suggested as inclusions:

1. In relation to the descriptive definition of honey from Australian native stingless bees:

> **Native bee honey** means the natural sweet substance produced by Australian native stingless bees from the genus *Tetragonula* or the genus *Austroplebeia* following the collection of nectar from the blossoms of plants.

2. In relation to the compositional requirements of honey from Australian native stingless bees:

> A food that is sold as 'native bee honey' must:
>
> - be honey produced by native stingless bees; and
> - contain:
>   - no less than 50% reducing sugars
>   - no less than 2% trehalulose
>   - no more than 28% moisture

These changes can be achieved by creating a new standard in Part 2.8 – *Sugars and Honey* that specifically permits honey from Australian native stingless bees as a food and includes a definition for honey from Australian native stingless bees.

A.2 A list of the foods likely to be affected by the proposed compositional change

Honey produced by native stingless bees will be a new standardised food which is distinct from honey produced by honey bees (*Apis mellifera*). Each will be defined separately. Other foods containing native bee honey will need to be labelling accordingly.

B. Information related to nutritional impact

B.1 Information on the nutritional content of the standardised food

The honey from Australian native stingless bees is an excellent source of essential nutrients, which are similar to those found in honey from *Apis mellifera*, as shown in the tables above and in **Appendix 8**.

The nutritional characteristics of the uncommon disaccharide, trehalulose, found in honey from stingless bees is still being investigated. However, it is known to have a much slower rate of release of its component monosaccharides into the bloodstream than sucrose (Yamada et al., 1985; Mizumoto et al., 2004), leading to both a low insulinemic index and a low glycemic index (Wach et al., 2010). Trehalulose is also reported to be acariogenic (Ooshima et al., 1991) and to have high antioxidant activity (Kowalczyk et al., 2015).

Based on the composition of honey from native stingless bees, the nutritional value of this honey is equivalent to honey produced by *Apis mellifera*.

Nutrition information on honey from Australian native stingless bees will be displayed in the nutrition panel on the honey product.

C. Information related to potential impact on consumer understanding and behaviour

C.1 Information to demonstrate consumer understanding of the proposed compositional change

Consumers have come to understand that a food product labelled 'honey' is the product of the honey bee, *Apis mellifera*. The introduction of a new food product which is also a honey but produced by native bees will require some changes, both at the regulatory level and at the education level, to ensure that consumers can choose correctly.

The motivation for consumers to choose honey from native bees will vary. For many, it will be the unique flavour of the honey. For others, it may be the fact that it is produced by Australian native bees rather than by the non-native European honeybees. And for some, it may be the presence of the unique sugar, trehalulose, which is found only in native bee honey (as discussed in section B.1).

Whatever the reason for their choice, consumers need to be sure that when the label says 'native bee honey' that this is the food product being sold.

It is proposed to address this matter in two ways – firstly, at the regulatory level and secondly, at the consumer level.

Regulatory level changes

At the regulatory level, it will be necessary to clearly distinguish these two foods which are both regarded by consumers as 'honey'. This is proposed to be addressed in two ways:

Firstly, a definition of native bee honey is proposed to be included in the proposed changes to Part 2.8 – *Sugars and Honey*.

The definition of honey from Australian native stingless bees proposed above in Section A.1 specifies the Australian native stingless bees in the genera *Tetragonula* or *Austroplebeia*. This will ensure that the food product being sold as native bee honey is indeed honey produced by native stingless bees.

Secondly, it is proposed that 'native bee honey' be a prescribed name in order that this food product not be confused with the food product 'honey' produced by *Apis mellifera*. This is discussed in the next section on labelling.

Consumer level changes

At the consumer level, it is proposed that media information such as website information and a printed brochure be prepared for consumers that would be available as the native bee honey comes on to the market.

It is expected that with the above changes, consumers would quickly become familiar with honey produced by native stingless bees and be able to distinguish it from honey produced by *Apis mellifera.*

C.2 Information to demonstrate that the proposed compositional change will not have adverse health or diet impacts on any population groups (eg age or cultural groups)

Honey produced by native stingless bees is not significantly different nutritionally from honey produced by *Apis mellifera*. The potential for the presence of pollen and/or propolis to impact sensitive individuals is the same as for *Apis mellifera* honey, as discussed below in section A.1. There is no reason to believe any other population group, such as the aged population or a particular cultural group, will be impacted differently to the general population. The media information proposed above will be available to all population groups and address any concerns.

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GUIDELINE 3.2.1 GENERAL FOOD LABELLING

In addition to the proposed changes in Part 2.8 – *Sugars and Honey*, this application proposes that the term ‘native bee honey’ be a prescribed name which would require a change to Part 1.2 – *Labelling and other information requirements* in the Food Standards Code. The application is also prepared, therefore, pursuant of Chapter 3.2.1 – *General Food Labelling.*

A. General information to support the proposed labelling change

A.1 A description of the proposed labelling change

This application is for the approval of honey produced by native stingless bees as a standardised food. It is proposed that the term ‘native bee honey’ be a prescribed name on this food.

A.2 A list of the foods or food groups likely to be affected by the proposed change

Honey produced by native stingless bees from the genera *Tetragonula* and *Austroplebeia*. Other food products containing this honey as an ingredient.

B. Information related to the potential impact on consumer understanding and behaviour

B.1 Information to demonstrate consumer support of the proposed labelling change

B.2 Information to demonstrate that the proposed labelling change will be understood and assist consumers

B.3 Information to demonstrate that the proposed labelling change will not have any adverse health or diet impacts on any population groups (eg age or cultural groups).

The matters referred to in the above sections are addressed under Chapter 3.2.4 - Labelling *for consumer information and choice*.

GUIDELINE 3.2.4 LABELLING FOR CONSUMER INFORMATION AND CHOICE

In addition to the proposed changes in Part 2.8 – *Sugars and Honey*, this application proposes that the term 'native bee honey' be a prescribed name which would require a change to Part 1.2 – *Labelling and other information requirements* in the Food Standards Code. The application is also prepared, therefore, pursuant of Chapter 3.2.4 – *Labelling for consumer information and choice* of the *Application Handbook* (FSANZ, 2019).

A. Additional information related to assisting consumers to make an informed choice

A.1 Information to show that the current labelling, or lack of labelling, or information from alternative sources does not allow consumers to make an informed choice

The ANBA proposes there are two main reasons why the term 'native bee honey' should be a prescribed name on the label of a food product containing honey produced by native stingless bees. These are discussed below:

Public health and safety

The term 'honey' is a prescribed name and listed as such in Standard 1.2.2. This arose from consideration of Proposal P181 – Review of sugars, honey and related products. According to the Inquiry report of this Proposal, it was considered necessary to prescribe the name 'honey' due to the concern that honey could potentially contain traces of pollen and/or royal jelly and therefore be a health risk to those individuals allergic to pollen and/or royal jelly and who may choice to avoid honey and foods containing honey.

The harvesting methods used to collect honey produced from native stingless bees is described in detail in **Appendix 6**. In the hive, honey is stored in grape-sized pots made from a wax/tree resin mixture referred to as propolis. Sometimes, some of the pots near the honey pots are used to store pollen. Thus, there is potential during harvesting for honey to be contaminated with small amounts of pollen despite various methods used to reduce this from occurring. There is also some potential for a small quantity of propolis to be present in honey.

With regard to the potential for the presence of royal jelly, this is considered to be less likely for native bee honey than for *Apis* honey. Royal jelly is a glandular secretion fed to larval bees and in *Apis mellifera* hives, royal jelly is fed to young larvae in open cells. It is possible that some of this jelly could contaminate the honey if, during extraction, a frame from the hive contained a small amount of brood as well as honey cells. In stingless bees, glandular secretions that could be analogous to the royal jelly of *Apis mellifera*, are also fed to larval bees, but the larval cells are closed and so contamination of honey with glandular secretions is less likely.

The same public health and safety concerns that resulted in 'honey' being a prescribed name also apply to honey produced by native stingless bees. By prescribing the name 'native bee honey' individuals allergic to pollen and/or propolis can choose to avoid food identified by this label.

Consumer choice and avoidance of misleading information

In Standard 2.8.2 the term 'honey' is described as the 'natural sweet substance produced by honey bees'. The term 'honey bee' generally refers to the European honey bee, *Apis mellifera* according to both the Macquarie Dictionary and the Australian Concise Oxford Dictionary. The common interpretation, therefore, is that honey is the product of *Apis mellifera* only. Therefore, consumers will have difficulty distinguishing honey produced by native stingless bees from honey produced by *Apis mellifera*.

Making 'native bee honey' a prescribed name would provide clarity to consumers that a food product labelled as 'native bee honey' is produced by Australian native stingless bees and not by *Apis mellifera*. It would also ensure that consumers would not be mislead by false labelling of *Apis mellifera* honey as native bee honey.

Consumers will quickly become accustomed to the 'native bee honey' label and be able to distinguish this food product from 'honey'. Further voluntary labelling is likely to be used to market native bee honey such as pictures of native bees, references to the native bee species, and other explanatory information on native bees.

Other labelling information relating to storage of native bee honey

A third, but less significant, reason why the term 'native bee honey' should be a prescribed name on the label of honey produced by native stingless bees relates to storage of the honey.

It has been noted above in Guideline 3.6.1 that some native stingless bee honeys have a higher moisture content and higher water activity than honey produced by *Apis mellifera*, and therefore may be more likely to support yeast growth and be susceptible to fermentation. While slight fermentation of native bee honey is not considered a serious issue and may be considered one of its characteristics, some consumers may associate it with spoilage. Slight fermentation will alter the flavour of the honey compared to freshly extracted honey.

In these cases, food manufacturers may choose to label their products with directions for storage, as described in Standard 1.2.6 *Information requirements – direction for use and storage,* and a best-before date as described in Standard 1.2.5 – *Information requirements – date marking of food for sale.*

Making 'native bee honey' a prescribed name would assist consumers by linking this food product with label directions for storage of the food.

Further information on the storage stability of honey from Australian native stingless bees together with a discussion of preservation techniques that will decrease the likelihood of fermentation in the stored product is provided in **Appendix 10.**

A.2 Information to show that there are no, or a limited number of, suitable alternative substitute products in all food categories currently available to consumers

Honey produced by native stingless bees is currently not permitted to be sold as a standardised food in Australia and New Zealand.

A.3 Information to show that the proposed specific labelling change will assist consumers to make an informed choice or will provide alternative labelling that will not hinder consumers from making an informed choice

By making the term 'native bee honey' a prescribed name, consumers who are concerned about the potential presence of bee pollen and/or propolis in the food will be able to avoid this food. In the case of *Apis mellifera* honey, prescribing the term 'honey' has been a proven way to assist those individuals with an allergy to bee pollen and/or royal jelly.

The growing consumer interest in native bee honey necessitates the need to have clear labelling that enables consumers to distinguish confidently this food from *Apis mellifera* honey. A prescribed name will provide that confidence and avoid consumers being misled by alternative names.

OTHER RELEVANT MATTERS

A. Contaminant data on honey from native stingless bees

The honey from Australian native stingless bees is traditionally harvested from wild bee populations by Aboriginal and Torres Strait Islander people and has been consumed as part of their normal diet for many thousands of years. See further information on traditional use in **Appendix 5**. There have been no reports of serious adverse effects from consumption of this food.

Native stingless bees and *Apis mellifera* share many of the same floral sources for nectar and pollen. Flavours in native stingless bee honey are imparted from both the floral nectar source as well as from the propolis storage pots in the nest.

There are no known contaminants or natural toxins in honey from Australian native stingless bees that could affect public health and safety.

Further information on contaminants in honey from native stingless bees is provided in **Appendix 8.**

B. Microbiological data on honey from native stingless bees

Data available on the microbiological content of honey from Australian native stingless bees demonstrates that it will meet the current microbiological limits in food.

To increase our understanding of the microbiology of native stingless bee honey, the Australian Native Bee Association obtained 21 samples of honey from four difference native bee species from 10 different beekeepers. Standard commercial microbiology tests for yeast, mould, aerobic plate count, *Salmonella* species and *Listeria* species (including L. monocytogenes) were performed by Eurofins Food Testing Australia (Haley & Heard, 2021).

The results are shown in Table 9 below. Samples kept at room temperature did not have higher numbers of microorganisms compared to refrigerated samples. A single *T. carbonaria* honey sample returned a positive result for a *Listeria* species. This was an indicator organism and was not *Listeria monocytogenes*. There were no public health and safety concerns raised by these results.

Table 9. Results of microbiological testing of native stingless bee honey

Species	**Replicates**	**Storage (months)**	**Aerobic plate count (cfu/g)**	**Yeast (cfu/g)**	**Mould (cfu/g)**	***Salmonella***	***Listeria***
T. hockingsi carbonaria mix, (room temp)	1	16	20	<10	<10	N.D.	N.D.
T. carbonaria	7	2 – 15	274 ± 505	<10	7 ± 6	N.D.	Detected in single sample
T. carbonaria (room temp)	1	19	20	<10	<10	N.D.	N.D.
T. hockingsi	7	1 – 25	63 ± 42	6 samples <10. Single sample 15000	10 ± 13	N.D.	N.D.
A. australis	3	1 - 2	640 ± 916	<10	23 ± 20	N.D.	N.D.
A. australis (room temp)	1	11	200	<10	<10	N.D.	N.D.
A. cassia	1	10	700	<10	<10	N.D.	N.D.

N.D. = Not detected.

Further discussion and references on the microbiological data on honey from Australian native stingless bees is provided in **Appendix 11.**

References

Haley, D., Heard T. (2021) *Microbial and physicochemical properties of honey from Australian Tetragonula and Austroplebeia stingless bees.* The Cross Pollinator Issue 20, April 2021.

APPENDICES

Appendix 1 Statutory Declaration

Appendix 2 Checklist for FSANZ application

Appendix 3 Australian Native Bee Association

Appendix 4 Native stingless bees and their management

Appendix 5 Traditional and contemporary use of native bee honey

Appendix 6 Harvesting methods

Appendix 7 Compositional data

Appendix 8 Nutritional data

Appendix 9 Contaminant data

Appendix 10 Storage stability data

Appendix 11 Microbiological data

Appendix 1. Statutory Declaration – Australia

Statutory Declarations Act 1959

I, Dean Haley, 8 Ellington Street, Tarragindi, QLD 4121, make the following declaration under the *Statutory Declarations Act 1959*:

1. the information provided in this application fully sets out the matters required
2. the information provided in this application to FSANZ regarding Australian native bee honey is true to the best of my knowledge and belief
3. no information has been withheld that might prejudice this application, to the best of my knowledge and belief

I understand that a person who intentionally makes a false statement in a statutory declaration is guilty of an offence under section 11 of the *Statutory Declarations Act 1959*,

and I believe that the statements in this declaration are true in every particular.

[*Signature of person making the declaration*]

Declared at 01 Barramul Street, Bulimba, QLD, 4171

on 3rd of July, 2022

Before me, PJC Stone JP (Qual)

PETER JEFFREY CHARLES STONE

54, Wellesley Street
Wellington Point
QLD 4160

JUSTICE OF THE PEACE (QUALIFIED)
Reg No: 78251
DEPT. OF JUSTICE & ATTORNEY-GENERAL

[*Signature of person before whom the declaration is made*]*

[*Full name, qualification and address of person before whom the declaration is made (in printed letters)*]

* A statutory declaration must be made before a prescribed person under the *Statutory Declarations Act 1959*

Appendix 2. Check list against The Application Handbook

Section in the Application Handbook	Completed
3.1.1 GENERAL REQUIREMENTS	
A. Form of the application	✓
B. Applicant details	✓
C. Purpose of the application	✓
D. Justification for the application D1. Regulatory impact information D2. Data requirements	✓
E. Information to support the application E1. Data requirements	✓
F. Assessment procedure	✓
G. Confidential commercial information	✓
H. Other confidential information	✓
I. Exclusive capturable commercial benefit	✓
J. International and other national standards J1. International standards J2. Other national standards or regulations	✓
K. Statutory declaration	✓
3.6.1 STANDARDISED FOODS	
A. General information to support the proposed compositional change A.1 A description of the nature of the proposed compositional change A.2 A list of the foods likely to be affected by the proposed compositional change	✓
B. Information related to nutritional impact	✓

B.1 Information on the nutritional content of the standardised food	
C. Information related to potential impact on consumer understanding and behaviour C.1 Information to demonstrate consumer understanding of the proposed compositional change C.2 information to demonstrate that the proposed compositional change will not have any adverse health or diet impacts on any population groups (eg age or cultural groups).	✓
3.2.1 GENERAL FOOD LABELLING	
A. General information to support the proposed labelling change A.1 A description of the proposed labelling change A.2 A list of the foods or food groups likely to be affected by the proposed change	✓
B. Information related to the potential impact on consumer understanding and behaviour B.1 Information to demonstrate consumer support of the proposed labelling change B.2 Information to demonstrate that the proposed labelling change will be understood and will assist consumers. B.3 Information to demonstrate that the proposed labelling change will not have any adverse health or diet impacts on any population groups (eg age or cultural groups).	✓
3.2.4 LABELLING FOR CONSUMER INFORMATION AND CHOICE	
A. Additional information related to assisting consumers to make an informed choice A.1 Information to show that the current labelling, or lack of labelling, or information from alternative sources does not allow consumers to make an informed choice A.2 Information to show that there are no, or a limited number of, suitable substitute products in all food categories currently available to consumers A.3 Information to show that the proposed specific labelling change will assist consumers to make an informed choice or will provide alternative labelling that will not hinder consumers from making an informed choice	✓

A.4 Information to demonstrate that, in the absence of the proposed labelling, alternative measures to address the issue would not be effective	

Appendix 3. Australian Native Bee Association

The Australian Native Bee Association Inc. (ANBA) promotes the conservation and sustainable use of all Australian bees. ANBA achieves that by providing resources, disseminating information, supporting members, and communicating with stakeholders.

The ANBA officially formed from the well-established Brisbane Native Beekeepers Club in June 2019.

The accomplishments since formation include:

1. Legal Incorporation in Queensland
2. Registration to operate nationally as a registrable Australian body with ASIC.
3. Website was launched, then revamped in 2022.
4. Member management software set up and operating.
5. Public liability insurance purchased.
6. Approx. 756 members joined by May 2022.
7. Eight branches have formed (Brisbane, Cassowary Coast, Rockhampton, Gladstone, Wide Bay, Sydney, Mid North Coast, and Coffs Harbour).
8. Over 4,000 Facebook followers recruited.
9. Held the third Australian Native Bee Conference in Sydney in June 2022.
10. Many educational native bee workshops have been conducted.
11. A honey sub-committee has been established.
12. A monthly newsletter, The Cross-Pollinator, has published 32 monthly issues.
13. Printed our first two “Annuals”, colourful informative amalgam physically mailed out to members.
14. Presented a vibrant series of monthly live public presentations.
15. We co-invested with AgriFutures Australia in a research project to investigate the trehalulose content of Australian stingless bee honey. The ANBA backed this proposal by pledging financial support and the honey samples for analysis.
16. With AgriFutures Australia, we developed the Australian Native Bee Strategic RD&E plan: https://www.agrifutures.com.au/product/australian-native-bee-strategic-rde-plan/
17. We teamed with Plant Health Australia to start a native bee biosecurity project.
18. Funding obtained for two bushfire recovery projects.

The objectives of the Australian Native Bee Association are:

(a) To promote, and protect the interests of its members (professional and amateur keepers of native bees)

(b) To support the protection and conservation of Australian native bees in the wild

(c) To represent industry policy at all levels of Government, private enterprise and the public

(d) To support the development of pollination services, honey production, trade in native bee husbandry products, educational services, and other relevant activities

(e) To disseminate information of interest and relevance to its members

(f) To conduct and encourage research

(g) To establish, authorise and support branches in areas where there is interest

(h) To secure business concessions and services for members

(i) Engage with indigenous communities and interests for exchange of knowledge.

ANBA Australian Native Bee ASSOC

Website: https://australiannativebee.org.au/

Australian Native Bee Association Inc., Management Committee

President: Ian Driver, Email: pres@australiannativebee.org.au

Vice President: Mark Hall, Email: Mark.Hall@westernsydney.edu.au

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Mid-north Coast Branch Representative: Diane Norris, diane.beewild@gmail.com

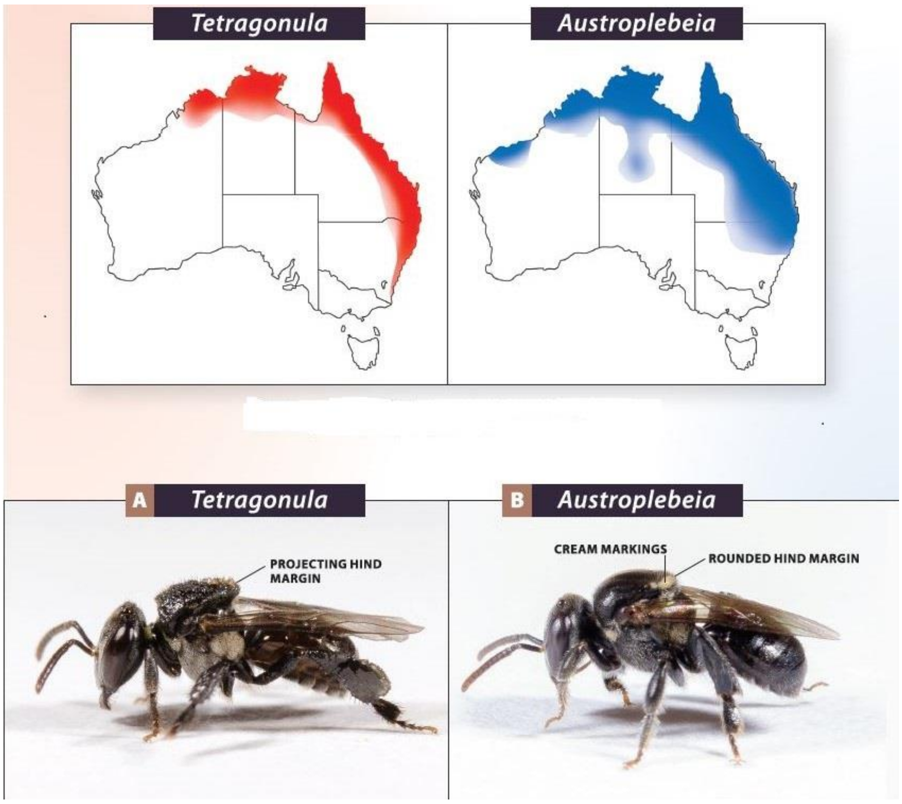
Coffs Harbour Branch Representative: Monica Rich, Monicarich00@gmail.com

Appendix 4. Native stingless bees and their management

In Australia, bees can be grouped into three broad categories – native solitary bees, native social bees, and introduced social bees. There are over 1600 species of native solitary bees. There are 11 species of native social bees – referred as stingless bees. There are two species of introduced social bees, namely, the European honey bee (*Apis mellifera)* and the Asian honey bee (*Apis cerana*).

Stingless bees are the only bees, other than *Apis*, that produce harvestable amounts of honey. The stingless bees form the tribe Meliponini in the family Apidae. There are 50 genera and 500 species distributed in most warmer parts of the world. Only two genera occur in Australia, the phylogenetically distant *Tetragonula* and *Austroplebeia* (Figure 4.1). Of the six species of *Tetragonula* occurring in Australia, two *T. hockingsi* and *T. carbonaria* are commonly kept and extracted of their honey. Of the five species of *Austroplebeia*, two *A. australis* and *A. cassia* are commonly kept and extracted for their honey. *T. carbonaria* has been the subject of most of the research conducted on Australian native stingless bees. The honey produced by *T. carbonaria* has also been more extensively studied than honey produced by other Australian stingless bee species. The two genera *Tetragonula* and *Austroplebeia* are phylogenetically distant, and this is reflected in some properties of their respective honey. In particular, *Austroplebeia* honey has a lower water content than *Tetragonula* honey, which sometimes can be <20%, and in this regard is similar to *Apis* honey.

Figure 4.1. Distribution and form of the two genera of Australian stingless bees



Keeping Australian native stingless bees is gaining popularity in the warmer parts of Australia where these bees occur naturally. Stingless bees suffer in extremely hot or cold weather and need to be protected from temperature extremes. For the past 30 years, keepers of Australian native stingless bees have been striving to develop effective hive box designs and have made great progress (Figure 4.2). They have also designed hives that allow the beekeeper to extract honey without damaging the colony (Figure 5.3).

Figure 4.2. A typical hive box design for colony propagation and honey extraction honey without damaging the colony (Left: closed hive. Right: *T. carbonaria* hive opened between bottom and mid box to show brood and the splitting process)

Great strides have also been made with beekeeping methods. Thousands of hives have been generated annually in Australia by dividing existing hives. The standard splitting technique involves separating two sections of a full hive and coupling each half with a new empty hive. Another technique called eduction is an alternative way of propagating colonies. The success rate of splitting hives is high.

Stingless bees attack each other's colonies to gain access and to install their own queen. This causes fighting swarms which can be managed to reduce bee losses.

Many pests attack stingless bee hives, but they can be managed. The most destructive pests are those that enter the nest and feed on the contents (hive syrphid fly, hive phorid fly, small hive beetle). Hives can be protected from pest entry by good design and construction, and by following good management practices. A potential brood pathogen has been identified but is currently extremely rare. Pests of honey bees do not affect stingless bees, with the one exception of small hive beetle. Even the feared varroa mite will not attack stingless bees.

Hives are increasingly being used for bush and crop pollination. Stingless bees boast several traits that make them valuable crop pollinators. Several crops are promising targets for pollination by stingless bees in Australia:

Hives also yield products including propolis and honey. Honey of Australia's most kept stingless bee (*Tetragonula carbonaria*) has excellent antimicrobial activity.

The structure of a stingless bee nest is different to an *Apis mellifera* nest. Apis store their honey in hexagonal wax cells arranged as honey comb. Stingless bees on the other hand store their honey in honey-pots made of propolis (a mixture of wax and plant resins). The honey-pots are not arranged in a honey comb like Apis, but are arranged in clusters similar to bunches of grapes (Figure 4.3).

Figure 4.3. *Austroplebeia australis* nest, brood cells in middle, honey pots at bottom right

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Appendix 5. Traditional and contemporary use of native bee honey

Traditional use by First Nations people

It is common knowledge that First Nations people have traditionally used the honey of Australian native bees. The deep history that Indigenous Australians have with native bees is recorded in their oral histories of stories, song and dance. Furthermore, native bees and their nests feature in artwork including bark paintings, rock shelter paintings, and woven honey collecting dilly bags.

Stories of native bees and honey may have ritual and totemic relevance in many indigenous communities. For many Indigenous Australians, native bees were integrated into the totem (moiety) system (Fijn, 2014), which provided a cultural, spiritual, and conservation framework for caring for bees and country.

The Yolngu of Arnhem Land provide an example of one groups' relationship with bees and honey. Natasha Fijn is an ethnographic researcher and observational filmmaker based at the Australian National University Mongolian Institute. In 2014, she accompanied Yolngu women and children in hunting for wild native bee honey (called 'sugarbag'). She says the Yolngu see 'sugarbag' as part of an interconnected system, linked to the hunters of the honey, the bees, their nests, the eucalyptus trees, the flowers, a particular fly that hangs around the nest, and the specific honey season (Fijn, 2014).

Honey is highly prized in indigenous communities, and there may be sharing obligations with family members and marital in-laws (Akerman, 1979). On some occasions, honey was traditionally mixed with water so that it could be consumed by a larger group of people. A sponge like material made from pounded plant fibers was dipped into the diluted honey and then sucked from the sponge (Love, 2009).

In "Honey in the life of the Aboriginals of the Kimberley" (Akerman, 1979) it is stated that honey was sometimes used as a medicine, whereby eating large quantities would produce a laxative effect (The ANBA honey committee cannot find any reports of consumers of honey actually experiencing laxative effects).

A study of 10 Arnhem Land languages (Si & Carew, 2018) found many words that described bees, nests, and honey. Different types of honey, including its taste and eating quality are classified under these traditional names. (Si & Carew, 2018).

Use by early European settlers

Records of early European settlers consuming the honey from Australian native bees can be found in numerous newspaper accounts. Some of these accounts date from the period before the European honey bee was successfully introduced in 1822. The earliest account found is from 1803 and was from a wild harvested nest (The Sydney Gazette and New South Wales Advertiser, Sunday 4 September 1803, Page 2).

Many newspaper accounts followed reporting on stingless bees and their honey, which was regarded as having an excellent flavor, perhaps superior to the honey of *Apis mellifera* (The Sydney Gazette and New South Wales Advertiser, Saturday 12 March 1842, Page 4; Goulburn Herald, Monday 31 July 1893, Page 4; Queenslander, Sat 20 September 1873, Page 5; Australasian, Saturday 20 August 1898, page 11).

Native bees were being housed in artificial boxes as early as 1854 (Sydney Morning Herald, Monday 9 October 1854, Page 9). Evidence of housing native bees in artificial boxes is credited to early native beekeepers such as Harold Hockings (Queenslander, Sat 2 September 1882, Page 3; Queenslander, Sat 27 January 1883, page 152) and Samuel George Shumack (Bathurst Free Press and Mining Journal, Thursday 25 January 1894, Page 3).

Further details of these newspaper accounts can be found in Chapter 3 of *The Honey of Australian Native Stingless Bees* (Haley, 2021).

Contemporary keeping of stingless bees in Australia

In 1998, 2010 and 2020, surveys of keepers of Australian native bees were conducted to learn more about their practices and their attitudes to beekeeping. The results showed that most colonies were kept in suburban areas on the east coast of Australia, in an area centered on south-east Queensland. Three species accounted for most hives kept: *Tetragonula carbonaria, T. hockingsi* and *Austroplebeia australis*. Most beekeepers used the Original Australian Trigona Hive (OATH) design or similar. In the decades between the surveys, the number of beekeepers increased rapidly as did the number of colonies kept (See Table below).

Although the stingless bee industry is growing at about 15% per year, it is still small compared to the honey bee industry, where 1,700 commercial keepers manage over 500,000 colonies. The following table summarises the key findings of the surveys, including preliminary results from a 2020 survey conducted by Sunayana Sajith (Sajith, 2021) and colleagues, published in the Cross-Pollinator Issue 19, March 2021.

	1998	2010	2020
No. of beekeepers responding	298	635	1448
No. of colonies kept	1425	4935	11442
Most popular species kept			
• *Tetragonula carbonaria*	69%	62%	62%
• *Tetragonula hockingsi*	20%	9%	21%
• *Austroplebeia australis*	11%	23%	7%
Nest locations			
• Suburban areas	56%	67%	65%
• Near bush	24%	21%	10%
• Rural areas	20%	13%	12%
Reasons for keeping bees			
• Enjoyment	81%	78%	
• Conservation	68%	67%	
• Pollinate bushland	27%	29%	
• Pollinate own crops	24%	24%	
• Crop pollination services for others	-	1%	
• Honey production	8%	11%	
• Hive sales	5%	4%	
• Education	2%	12%	
• Research	2%	4%	
State where beekeepers live			
• Queensland	71%	61%	51%
• New South Wales	29%	38%	48%
• Northern Territory	<1%	<1%	<1%
State where nests are kept			
• Queensland	91%	84%	
• New South Wales	9%	16%	
• Northern Territory	<1%	<1%	
Honey production			
• Number of beekeepers	26	63	
• Number of hives	542	1725	
• Total honey production per year in kg	90	254	
Bee colony propagation			
• Number of beekeepers only transferring nests	58	99	
• Number of nests transferred	1240	5093	
• Number of beekeepers only dividing colonies	17	139	
• Number of nests involved	857	6328	
• Number of beekeepers manipulating nests	119	238	

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Newspaper reports

The Sydney Gazette and New South Wales Advertiser, Sunday 4 September 1803, Page 2

The Sydney Gazette and New South Wales Advertiser, Saturday 12 March 1842, Page 4

Goulburn Herald, Monday 31 July 1893, Page 4

Queenslander, Sat 20 September 1873, Page 5

Australasian, Saturday 20 August 1898, page 11

Sydney Morning Herald, Monday 9 October 1854, Page 9

Queenslander, Sat 2 September 1882, Page 3

Queenslander, Sat 27 January 1883, page 152

Bathurst Free Press and Mining Journal, Thursday 25 January 1894, Page 3

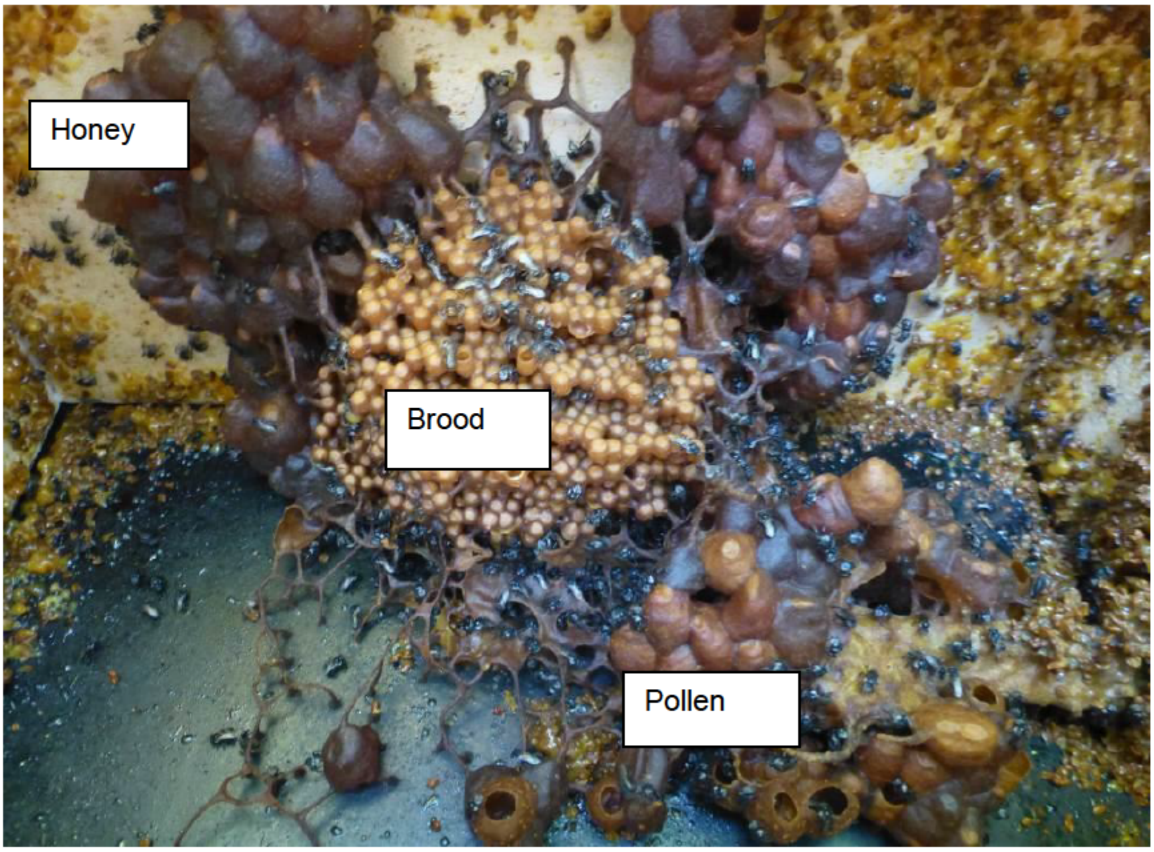
Appendix 6. Harvesting methods

Honey from stingless bees

Australian native stingless bees collect nectar from flowers, process it into honey and store it for later consumption. The honey can be easily harvested from hives, as discussed below, and a typical stingless beehive will yield about 1 kg of honey per year. In general, honey from *Tetragonula* species is of lower viscosity and acid pH, while *Austroplebeia* species honey is of higher viscosity and more neutral pH. The hive structures of these species are also different and together these characteristics can influence which harvesting method is the most appropriate.

The honey produced by Australian native stingless bees is a natural product that has been exploited by indigenous Australians for thousands of years, and by post colonisation Australians since at least 1803. The nectar collected by Australian native stingless bees is stored in their gut and processed by digestive enzymes and bacteria. The bees further process the nectar by regurgitating it and spinning droplets of the liquid in their mouth parts to reduce the water content. Finally, the processed nectar is regurgitated into a honey pot, built from a mixture of bee wax (referred to as propolis) and tree resins. The honey pot is then sealed. The structure of honey pots in a natural nest can be seen in Figure 6.1. The pots can also be used to store pollen.

Figure 6.1. *Tetragonula hockingsi* showing honey, brood and pollen



Honey storage in artificial stingless bee hives

In an artificial stingless bee hive, the bees will store honey is a similar way to that seen in a natural nest, with the honey pots arranged around the centrally positioned brood (Figure 6.2). However, the bees can be encouraged also to store some of their honey separately from the brood by placing a small box (referred to as a honey section or honey super) on top of a brood excluder above the hive (Figure 6.3). The bees will fill this honey super with pots which are filled mainly with honey, but some may also contain pollen. The honey can be more easily collected from this honey super, as described below.

Figure 6.2. *Austroplebeia australis* showing honey, brood and pollen

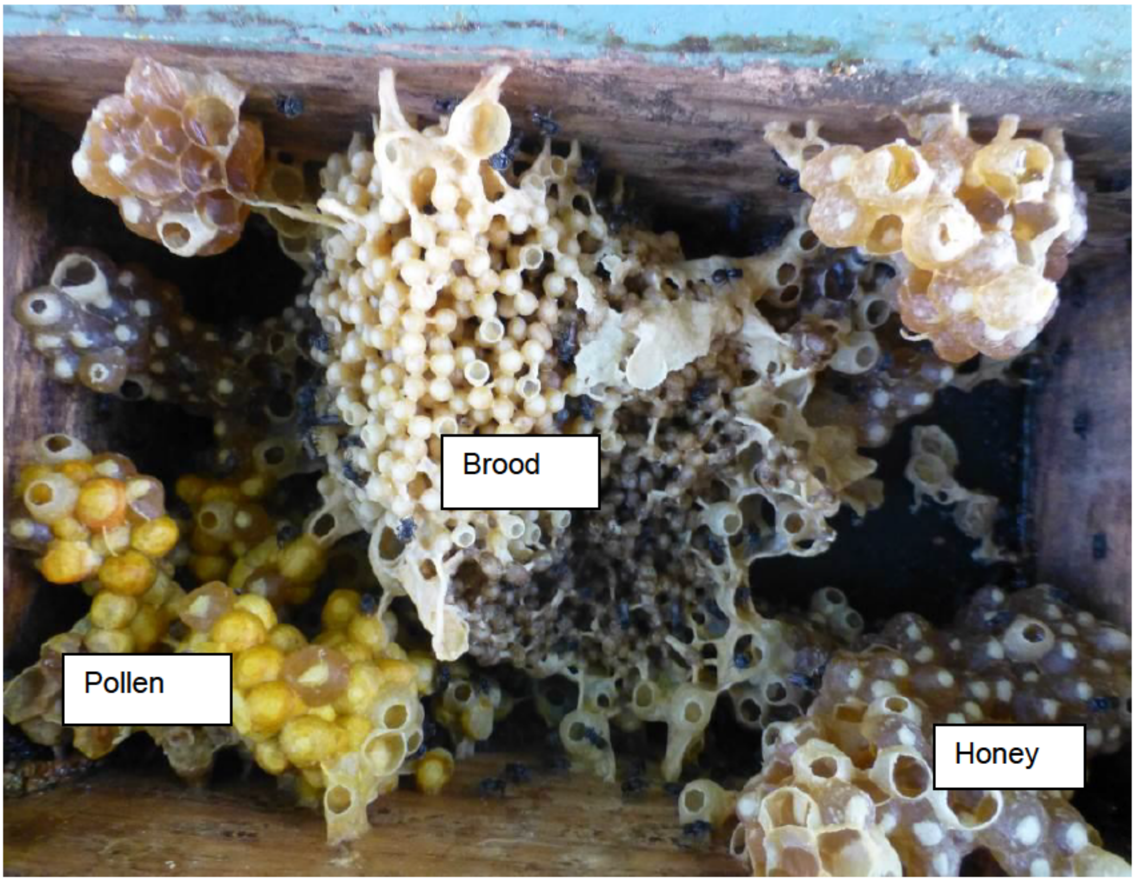


Figure 6.3. The honey section has been lifted off this hive to show the pots of honey built as a mass in this part of the hive. (Left empty showing internal design, right removing the honey box to reveal the stored honey)

Honey collection methods

The nature of stingless bee honey storage in the hive presents challenges regarding harvesting. The adjacent storage of honey and pollen necessitates using careful harvesting techniques to minimise mixing of both pollen and propolis with the honey. The use of a honey super can assist honey harvesting and minimise hive disturbance.

Various honey harvesting methods have been used globally, as follows:

1. Multiple honeypot puncture and gravity drainage. This is the most widely used method in Australia and involves puncturing the honeypots in the honey super with various tools from a clean fork to custom-built ‘bed of nails (Figure 6.4). If these tools are used, food safety principles should be followed by using stainless steel nails and sealing the wooden base with a food safe polymer. Gravity drainage can then be used to harvest the honey before further filtration to remove hive debris.
2. Multiple honeypot puncture and centrifugation. This method requires the use of a pre-formed honeypot layer that lends itself to centrifuging. This method is used by several beekeepers who uses various wooden or synthetic (e.g. plastic) honey frames that confine honeypots to a single layer. Honey is removed from the frames using a centrifugal extractor built from food safe stainless steel.

3. Suction aspiration of honeypots. This method is used in Asia and to a lesser degree in Tropical America, where some stingless species create larger honeypots, but it is labour-intensive for the small honeypots of Australian stingless bee species.

4. Removal of honeypots from around brood in the hive. This method is quite destructive, involving significant disruption of the hive, but has been used successfully with *Austroplebeia australis* where the honey pots are made from extremely thin and delicate wax. The honey is then harvested by squashing or crushing the honeypots.

5. Use of hive designs that encourage bees to store honey directly in the intended final container. These hive designs are still at an early stage of development.

Figure 6.4. Honey extraction using puncture and drain. Left: Using a bed of nails to pierce the honey pots. Right: First filtering of the honey.

Harvested honey

Harvested honey is strained through a food-safe strainer to remove hive debris and dead bees. The aroma, clarity, taste, and shelf-life of the honey can vary with the harvesting method. Beekeepers show varying degrees of sensitivity when piercing the honeypots - careful work can assist in avoiding the pollen pots that are often present together with the honeypots in a honey super.

The harvested honey is stored in a sealed container to prevent contamination and kept cool before packaging.

Stingless beekeeper information and awareness

Methods for harvesting honey from Australian native stingless bees, and general awareness of food safety requirements are promoted by a variety of individual producers via their web sites. Tim Heard's book *The Australian native Bee Book: Keeping stingless bee hives for pets, pollination and sugarbag honey* (Heard, 2016), and Dean Haley's book *The Honey of Australian Native Stingless Bees* (Haley, 2021) both contain specific advice for honey producers.

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Heard, T.A. (2016) *The Australian native Bee Book, keeping stingless bee hives for pets, pollination and sugarbag honey*. Sugarbag Bees, Brisbane.

Appendix 7. Physicochemical data

The eleven species of stingless bees that live in Australia share many properties with the more than 500 species of stingless bees worldwide. All produce honey that is stored in so-called 'pots' within nests that have common structural characteristics. The properties of stingless bee honey from a number of countries have been examined and display features that are common to all stingless bee honey. Most of these studies have been conducted in Central and South American countries where stingless bee honey has been collected for food and medicinal use for centuries (Vit et al., 2013). Studies conducted on Australian stingless bee honey show that its composition and physicochemical properties are similar to honey from stingless bees in other parts of the world (Souza et al., 2006; Nordin et al., 2018).

Honey produced by most stingless bee species has a higher moisture content, acidity, and electrical conductivity than honey produced by honeybees (Persano Oddo et al., 2008) (Table 7.1). The sugar composition is also different to *Apis mellifera* honey, stingless bee honey has lower glucose and fructose levels, and contains high levels of an unusual disaccharide, trehalulose (Fletcher et al., 2020). This is discussed further in Appendix 8.

Recent studies commissioned by the Australian Native Bee Association have confirmed the earlier studies on honey from *Tetragonula* species (Table 7.1) and provided new information on honey from *Austroplebeia* species (Haley & Heard, 2021) (Table 7.2).

Further recent studies have provided additional data on honey produced by *Tetragonula carbonaria* and *Tetragonula hockingsi* species (Zawawi et al., 2022). This information is provided in Table 7.3.

7.1 *Tetragonula* honey

Table 7.1 Physicochemical characteristics of honey produced by *Tetragonula carbonaria* (Persano Oddo et al., 2008)

Parameter	***Average (n = 8)***	**Standard Deviation**	**Range**
Moisture (g/100 g)	26.5	0.8	25.3 – 27.5
pH	4.0	0.1	3.9 – 4.2
Water activity (A_w)	0.74	0.01	0.73 – 0.75
Free acidity (meq/kg)	124.2	22.9	94 – 156
HMF (mg/kg)	1.2	0.6	0.4 – 2.1
Diastase	0.4	0.5	0.1 – 1.7
Invertase	5.7	1.5	3.7 – 8.4
Ash (g/100g)	0.48	0.06	0.37 – 0.56
Electrical conductivity (mS/cm)	1.64	0.12	1.3 – 1.7

Table 7.2 Physicochemical characteristics of honey produced by *Tetragonula* species with refrigerated or room temperature storage post harvest (Haley & Heard, 2021).

Refrigerated temperature storage 2 to 22 months post harvest				**Room temperature storage 19 months post harvest**
Parameter	**Average (*n* = 6)**	**Standard Deviation**	**Range**	**Result (n = 1)**
Moisture (%)	26.4	2.9	24.4 – 31.8	27
pH	4.0	0.4	3.5 – 4.7	3.5
Free Acid (meq/kg)	87.5	39.8	29.4 – 143.8	291.9
HMF (mg/kg)	3.0	5.6	0.1– 14.3	79.6
Diastase	0.1	0.1	0.0 - 0.3	0

Table 7.3 Physicochemical characteristics of honey produced by *Tetragonula carbonaria* and *Tetragonula hockingsi* species (Zawawi et al., 2022).

	***Tetragonula carbonaria* (n = 11)**			***Tetragonula hockingsi* (n = 10)**		
Parameter	**Average**	**SD**	**Range**	**Average**	**SD**	**Range**
Moisture (%)	25.48	0.85	23.91-26.88	25.15	1.16	23.75-27.66
pH	3.6	0.06	3.5-3.71	3.63	0.13	3.44-3.88
Free Acid (meq/kg)	167.8	32.8	98.5-212.3	125.4	40.9	74.1-202.0

7.2 *Austroplebeia* honey

The main physicochemical characteristics of honey produced by *Austroplebeia* species, are shown below (Table 7.4). A single sample stored at room temperature is provided for comparative purposes.

Table 7.4 Physicochemical parameters of honey produced by *Austroplebeia* species (Haley & Heard, 2021).

Refrigerated temperature storage 1 to 10 months post harvest				**Room temperature storage 22 months post harvest**
Parameter	**Average (*n* = 13)**	**Standard Deviation**	**Range**	**Result (n = 1)**
Moisture (%)	19.9	1.2	17.4 – 22.0	20
pH	4.6	0.7	3.8 – 6.4	3.9
Free Acid (meq/kg)	27.2	16.4	8.6 – 60.0	51.3
HMF (mg/kg)	3.7	4.9	0.0 – 14.1	142.9
Diastase	0.2	0.4	0.0 – 1.1	0

Haley & Heard (Haley & Heard, 2021) found that the average moisture content of honey produced by *Austroplebeia* is 19.9%, which is similar to the moisture content of honey produced by *Apis mellifera* (16-18% according to a 1999 RIRDC report). The low moisture content of *Austroplebeia* honey may increase its storage capability at room temperature, as evidenced by the lower free acid content found in *Tetragonula* honey after storage.

Free Acidity is used as a quality indicator in *Apis mellifera* honey to detect undesired fermentation, with maximum acceptable acidity being 50 meq/kg (Codex Standard 12, 2001). There is some variation in the free acidity of native bee honey which most probably indicates variable levels of fermentation. It is noted that 11 of the 13 *Austroplebeia* honey samples individual results which contributed to Table 6.4 were less than 50 meq/kg, while only 1 of the 6 individual *Tetragonula* honey results which contributed to Table 7.2 were less than 50meq/kg, meaning that fermentation is more pronounced in the *Tetragonula* genus (Haley & Heard, 2021). In stingless bee honey, fermentation is an accepted feature of the honey, and the higher free acidity values do not reflect on the quality of the honey.

HMF (hydroxymethylfurfural) is formed by the breakdown of sugars in the presence of an acid. The results of Haley & Heard (Haley & Heard, 2021) showed that stingless bee honey stored at refrigerated temperatures has low values of HMF than honey stored at room temperature because of the slower breakdown of sugars at refrigerated temperatures. HMF levels are naturally high in many common foods including coffee, baked cookies, and dried fruit (Shapla et al., 2018).

Diastase is an enzyme that breaks down starch into sugars. The results of Haley & Heard (Haley & Heard, 2021) indicate that diastase is not a predominant enzyme in stingless bee honey from *Tetragonula* or *Austroplebeia* and is not suitable as a quality indicator for the honey from stingless bees.

7.3 *Apis* honey

The main physicochemical characteristics of honey produced by the European honey bees, compared to that of Australian *Tetragonula*, and *Austroplebeia* species, are shown below (Table 7.5).

Table 7.5 Average (or range) of physicochemical parameters of honey produced by European honey bee, Australian *Tetragonula*, and *Austroplebeia* species

Parameter	*Apis mellifera*	*Tetragonula*	*Austroplebeia*
Average Moisture (%)	17	26.4	19.9
Average pH	3.9	4.0	4.6
Water activity $A_{w)}$	0.49-0.63	0.74	-
Free Acid (meq/kg)	12 – 114	29 – 292	9 – 60
HMF (mg/kg)	0 – 700	0.1 – 80	0 – 143
Diastase (Schade Units)	9 – 32	0.1 – 1.7	0 – 1.1

From: Somerville et al., 2017; de Melo et al., 2017; Haley & Heard, 2021; Cavia et al., 2004.

7.4 Comparation of physical parameters

The typical range for physicochemical parameters for native bee honey compared to Codex specifications and Standard 2.8.2 requirements is shown in Table 7.6.

Table 7.6 Typical range for physical parameters for native bee honey from all studies compared with Codex specifications and Standard 2.8.2 requirements.

Parameter	***Apis mellifera* honey requirements**		**Native bee honey results**	
	Codex specifications	**Standard 2.8.2**	***T. carbonaria*** A. Persano Oddo et al, 2008 B. Haley & Heard, 2021	**B. australis** Haley & Heard, 2021
Moisture %	<20	<21	25.3 – 27.5 (A) 24.4 – 31.8 (B)	17.4 – 22.0

Reducing Sugars (g/100g)	>60	>60	Average 62.3 (A)	Average 59
Electrical conductivity (mS/cm)	Maximum 0.8 *	N/A	1.3 – 1.7 (A)	unknown
Free Acidity (mEq/kg)	Maximum 50 *	N/A	94 – 156 (A) 29.4 – 143.8 (B)	8.6 – 51.9
HMF (mg/kg)	<80 * (Tropical regions)	N/A	0.4 – 2.1 (A) 0.1 – 14.3 (B)	0 - 14
Diastase (Schade units)	>8 *	N/A	0.2 – 1.7 (A) 0.0 – 0.3 (B)	0 – 1.1
pH	N/A	N/A	3.9 – 4.2 (A) 3.5 – 4.7 (B)	3.8 – 6.4

Note: Codex Alimentarius specifications noted with an * are optional, and "is intended for voluntary application by commercial partners, and not for application by governments".

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Appendix 8. Nutritional data

The composition and antioxidant activity of stingless bee honey produced by *Tetragonula carbonaria* has been examined by Persano Oddo et al., (Persano Oddo et al., 2008). The relevant nutritional data is provided in Table 8.1.

Table 8.1 Nutritional data on *Tetragonula carbonaria* honey (Persano Oddo et al., 2008)

Parameter	**Average (*n* = 8)**	**Standard deviation**	**Range**
Moisture (g/100g)	26.5	0.8	25.3-27.5
Fructose (g/100g)	24.5	1.9	21.8-27.4
Glucose (g/100g)	17.5	2.8	14.3-22.7
Trehalulose (g/100g)*	20.3	2.9	15.3-22.8
Sucrose (g/100g)	1.8	0.4	0.9-2.2
Fructose + glucose (g/100g)	42.0	4.5	36.1-50.1
Total sugar (g/100g)	64.1	1.9	60.5-66.3
Reducing sugars (g/100g) **	62.3	-	-

*Reported as maltose, but subsequently identified as trehalulose (Fletcher et al., 2020)

** Estimated by adding the values for glucose, fructose, and maltose (trehalulose)

Recent studies by Zawawi (Zawawi et al., 2022) on honey from *Tetragonula carbonaria* and *Tetragonula hockingsi* has confirmed the data for the sugar spectrum for *Tetragonula carbonaria* and provided new data for *Tetragonula hockingsi*. This data is provided in Table 8.2.

Table 8.2. Sugar content of honey from *Tetragonula carbonaria* and *Tetragonula hockingsi* (Zawawi et al., 2022).

Parameter	**Honey produced by *Tetragonula carbonaria* *n = 11***		**Honey produced by *Tetragonula hockingsi* n = 10**	
	Average	**Range**	**Average**	**Range**
Fructose (g/100g)	17.43	12.98-22.4	16.58	10.48-20.60
Glucose (g/100g)	12.10	7.81-15.26	12.71	6.39-16.91
Sucrose (g/100g)	ND	ND	ND	ND
Trehalulose (g/100g)	23.18	18.03-35.45	24.90	18.62-38.75

Recent studies commissioned by the Australian Native Bee Association have provided nutritional data on honey produced by *Austroplebeia australis* (Haley & Heard ,2021). See Table 8.3.

Table 8.3 Nutritional data on *Austroplebeia australis* honey (Haley & Heard, 2021)

Parameter	**Average (*n* = 10)**	**Standard Deviation**	**Range**
Fructose (g/100g)	33.1	1.9	29.9 – 36.1
Glucose (g/100g)	19.4	2.9	14.5 – 24.0
Sucrose (g/100g)	6.0	4.8	0.0 – 13.0
Trehalulose (g/100g) *	3.7	0.9	2.7 – 4.9
Turanose (g/100g)**	2.9	0.9	1.6 – 4.3
Reducing sugars (g/100g)	59.0	3.4	55.3 – 61.6
Total sugars (g/100g)	65.0	2.3	61.5 – 68.4

*Reported as maltose, but subsequently identified as trehalulose (Haley & Heard, 2021)
**Turanose identity to be confirmed.

Recent studies from the University of Queensland have been completed and submitted to AgriFutures Australia (Fletcher, Hungerford and Smith, 2021). This work further describes sugar spectrums in *Austroplebeia* and *Tetragonula* honey, including further descriptions of origins (Hungerford et al., 2021) and quantities of the disaccharide trehalulose found in these honey's (see tables 8.4 and 8.5). Additionally, this report provides new data on the organic acid profiles found in *Austroplebeia* and *Tetragonula* honey. These profiles show the presence of Acetic, Gluconic, and Lactic acid, with traces of other organic acids.

Table 8.4 Nutritional data on *Tetragonula* honey (Fletcher, Hungerford and Smith, 2021)

Sugar	Average (*n* = 89)	Standard Deviation	Range
Erlose (g/100g)	0.1	0.3	0.0 – 2.2
Fructose (g/100g)	18.8	8.8	0.0 – 39.7
Glucose (g/100g)	11.9	8.4	0.0 – 3.5
Maltose (g/100g)	0.09	0.37	0.0 – 3.5
Sucrose (g/100g)	Not detected		
Trehalulose (g/100g)	18.5	11.6	0.0 – 48.7

Table 8.5 Nutritional data on *Austroplebeia* honey (Fletcher, Hungerford and Smith, 2021)

Sugar	Average (*n* = 22)	Standard Deviation	Range
Erlose (g/100g)	0.21	0.73	0.0 – 3.5
Fructose (g/100g)	30.5	5.8	13.9 – 37.1
Glucose (g/100g)	17.1	5.5	0.0 – 22.7
Maltose (g/100g)	Not detected		
Sucrose (g/100g)	2.1	3.0	0.0 – 10.1
Trehalulose (g/100g)	4.5	3.7	0.0 – 15.0

Honey produced by *T. carbonaria* is a good source of energy provided by the sugars, fructose and glucose, although the fructose and glucose levels are lower than those in *Apis* honey. Honey from both *T. carbonaria* and *T. hockingsi* also contains high levels of an unusual disaccharide, trehalulose (Fletcher et al., 2020). This disaccharide has been previously found in stingless bee honey but incorrectly reported as maltose (Persano Oddo et al., 2008). Trehalulose is an isomer of sucrose with an unusual α-(1→1) glucose-fructose glycosidic linkage. It has previously been reported as a minor sugar in some *Apis* honeys (Sanz et al., 2004; de la Fuenti et al., 2011). It has a much slower rate of release of monosaccharides into the bloodstream than sucrose (Yamada et al., 1985; Mizumoto et al., 2004), leading to both a low insulinemic index and a low glycemic index (Wach et al., 2010). Trehalulose is also reported to be acariogenic (Ooshima et al., 1991) and to have high antioxidant activity (Kowalczyk et al., 2015).

Honey produced by *Austroplebeia australis* has higher levels of fructose than that produced by *T. carbonaria* and the levels of trehalulose in *A. australis* honey are lower, but the total sugar content is similar. The sucrose level in honey from *A. australis* is higher than that found in honey from both *T. carbonaria* and *Apis mellifera* (see Table 8.2).

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Appendix 9. Contaminant data

There have been no reports of adverse effects from consumption of honey produced by stingless bees in Australia resulting from the presence of natural toxins or environmental contamination. Aboriginal and Torres Strait Islander people have consumed the honey collected from wild populations as part of their normal diet for many thousands of years.

Natural toxins

Native stingless bees and *Apis mellifera* share many of the same floral sources for nectar and pollen, so it is unlikely that stingless bees would introduce a new natural toxin derived from a floral source. One natural toxin that can be found at low levels in *Apis* honey is pyrrolizidine alkaloids derived from various plant species, the major one being *Echium* species, such as Paterson's Curse. The distribution of stingless bees is more restricted than for *Apis mellifera* and ranges from the northern tropical regions down along the east coast of Qld and NSW. The major distribution of Paterson's Curse is the western areas of the southern states where stingless bees are not found. So, although detectable levels of pyrrolizidine alkaloids in native bee honey might occur in the future, the levels are likely to be very low. Consumption levels of native bee honey are also low compared to the consumption levels of *Apis* honey. There are no other known contaminants or natural toxins in native stingless bee honey that could raise safety concerns.

Environmental contaminants

The presence of environmental contaminants in stingless bee honey has been examined by Hungerford et al., (Hungerford et al., 2020). Analyses included pesticides, herbicides, polycyclic aromatic hydrocarbons (PAHs) and trace elements. In all cases, the results showed low or negligible levels of pesticide, herbicide, and PAH contamination.

It is anticipated that honey produced by native stingless bees would be randomly monitored for environmental contaminants by State and Territory health authorities in the same way as honey from *Apis mellifera* is monitored.

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Appendix 10. Storage stability data

Honey from Australian native stingless bees may be stored at room temperature or refrigerated. Anecdotal information indicates that the honey may be stored and consumed for many years.

Native stingless bee honey has a water content that is usually greater than 21%. This water content may allow native stingless bee honey to ferment from bacterial and yeast micro-organisms naturally found in association with stingless bees. Fermentation can sometimes occur in bottled honey stored at room temperature and is evidenced by small bubbles rising to the surface of the honey, or a release of pressure when the cap is removed from the product. As honey fermentation is observed to occur naturally inside stingless beehives (Heard, 2016), the Australian Native Bee Association honey subcommittee considers this to be a natural quality of native stingless bee honey.

Some consumers interpret fermentation as food spoilage, even though it is a natural process and not related to the safety of the food. As consumers become more familiar with native stingless bee honey, concerns regarding fermentation should diminish.

There are several preservation techniques presented below that will decrease the likelihood of fermentation in the stored product. Some of these techniques are currently used in Australia, and some are used in other countries which harvest and sell stingless bee honey. The choice of preservation technique and storage condition of the packaged product be at the discretion of the native stingless bee honey producer. We recommend that if pasteurisation, dehydration or fermentation to maturity is used on the honey, then it be declared on the label.

Methods to limit fermentation

Limiting Pollen Contamination

It is reported that limiting pollen contamination during harvesting will decrease the likelihood of fermentation of native stingless bee honey (Heard, 2016).

Pollen content in bulk honey can be reduced by allowing native bee honey to settle post-harvest, which allows pollen to float to the surface. The pollen free honey can then be drained from the base of the container.

Refrigeration

Refrigeration of native stingless bee honey is widespread in Australia (Heard, 2016). Refrigeration is recognised as increasing the shelf life of many food products.

Pasteurisation

Pasteurisation is used in Brazil to decrease the viability of yeast in stored stingless bee honey (Brazilian Normative Instruction 2019; Villas-Boas, 2018). This preservation technique is not currently used in Australia.

Dehydration

Dehydration is a technique to reduce water content to less than 21%. Native stingless bee honey with reduced water content will not allow even osmotolerant yeast to ferment. This technique is used in Malaysia and Brazil (Malaysian Std 2018; Brazilian Normative Instruction 2019; Villas-Boas 2018). This preservation technique is not currently used in Australia.

Fermentation to maturity

In this technique, stingless bee honey is allowed to ferment due to the metabolic action of yeasts and bacteria naturally present in the stingless bee honey (Brazilian Normative instruction, 2019). The honey is not inoculated with yeast or starter culture, only the naturally occurring, and naturally present micro-organisms are used. The stingless bee honey is stored at room temperature until fermentation has slowed and no further gas bubbles are observed rising to the surface. At this time, the honey is packaged and sold to consumers. This preservation technique is not currently used in Australia.

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Appendix 11. Microbiological data

The microbial quality of honey produced by native stingless bees has been considered in relation to Standard 1.6.1 - Microbial limits in food, Schedule 27 – Microbial limits in foods, and the Compendium of Microbial Criteria for Food (FSANZ Sep 2018). The Australian Native Bee Association honey subcommittee does not consider food pathogens are likely to be present in native stingless bee honey. The subcommittee is not aware of any instance of a person becoming ill from micro-organisms found in native stingless bee honey.

Native stingless bee honey has a water content that is usually greater than 21%. This water content may allow native stingless bee honey to ferment from bacterial and yeast micro-organisms naturally found in association with stingless bees. Fermentation can sometimes occur in bottled honey stored at room temperature and has been observed to naturally occur in the honey stored in the hive.

The bacterial symbionts of three species of stingless bees, namely, *Tetragonula carbonaria*, *Tetragonula hockingsi* and *Austroplebeia australis* have been studied by Leonhardt and Kaltenpoth (Leonhardt & Kaltenpoth ,2014). Besides common plant bacteria, lactic acid bacteria (LAB) were found in all three species, showing that LAB are shared by honeybees, bumblebees and stingless bees across geographical regions.

Massaro (Massaro et al., 2018) surveyed the yeasts associated with the honey and other parts of the nest of *Tetragonula carbonaria*, *Tetragonula hockingsi* and *Austroplebeia australis.* No yeasts were isolated from any of the brood food samples, but originated from the cerumen, pot pollen and honey. These included *Starmerella meliponinorum*, Candida species and other Ascomycota and Basidiomycota species. Bacteria (Proteobacteria, Firmicutes) previously identified in bee guts were also detected.

Toby Mills (Mills, 2018) cultured the bacteria and fungi from the gut and cuticle of three species of Australian stingless bees, namely, *Tetragonula carbonaria*, *Tetragonula hockingsi* and *Austroplebeia australis* and screened by genetic and chemical methods to create a subset enriched for chemical diversity and biosynthetic potential.

Dr Scott Oliphant at the University of Adelaide is currently undertaking research into the bacteria of the honey of *Tetragonula carbonaria*, *Tetragonula hockingsi* and *Austroplebeia australis*. Preliminary results show the existence of a wide range of bacteria.

It is reasonable to assume that organisms associated with the bees and associated with the nesting material could be found within the honey for at least a short period following honey harvesting. It can also be assumed that microorganisms that can persist in bottled native stingless bee honey are predominantly osmophilic and osmotolerant yeasts and bacteria.

To increase our understanding of the microbiology of native stingless bee honey, the Australian Native Bee Association obtained 21 samples from 10 different beekeepers. Standard commercial microbiology tests were performed by Eurofins Food Testing Australia (Table 11.1). (Haley & Heard, 2021)

Table 11.1. Standard commercial microbiology tests performed on honey samples (Haley & Heard, 2021)

Test Code	Test conforms to	Test method description
NV083-1	GB 4789.15-2016	Enumeration of yeast & mould (Cultural technique, non chromogenic media)
NV09K-1	AOAC 990.12	Aerobic plate count (Cultural technique, pectin gel)
NV03P-1	AS 5013.10	Detection of salmonella (D-Cultural technique, chromogenic + non chromogenic media)
NV01M-2	AOAC 061701	Detection of Listeria species & Listeria monocytogenes (RT-PCR)

The microbial results can be seen in Table 11.2. Samples kept at room temperature did not have higher numbers of microorganisms compared to refrigerated samples. A single *T. carbonaria* honey sample returned a positive result for a *Listeria* species. This was an indicator organism and was not *Listeria monocytogenes*.

Table 11.2. Microbiological results of 21 honey samples representing 10 beekeepers, four bee species, harvested by three methods and stored in two different conditions for varying periods. (Haley & Heard, 2021)

Species	Replicates	Storage (months)	Aerobic plate count (cfu/g)	Yeast (cfu/g)	Mould (cfu/g)	*Salmonella*	*Listeria*
T. hockingsi carbonaria mix, (room temp)	1	16	20	<10	<10	N.D.	N.D.
T. carbonaria	7	2 – 15	274 ± 505	<10	7 ± 6	N.D.	Detected in single sample
T. carbonaria (room temp)	1	19	20	<10	<10	N.D.	N.D.
T. hockingsi	7	1 – 25	63 ± 42	6 samples <10. Single sample 15000	10 ± 13	N.D.	N.D.
A. australis	3	1 - 2	640 ± 916	<10	23 ± 20	N.D.	N.D.
A. australis (room temp)	1	11	200	<10	<10	N.D.	N.D.
A. cassiae	1	10	700	<10	<10	N.D.	N.D.

N.D. = Not detected.

Anti-microbial activity

The honey of *Tetragonula carbonaria* has excellent antimicrobial properties against many pathogenic bacteria which further enhances the safety of native stingless bee honey. This has been corroborated by studies at three Australian university laboratories that used a variety of techniques to analyse the effect of stingless bee honey on a range of pathogenic microbes (Irish et al. 2008; Boorn et al. 2010; Massaro 2014). Compared to manuka medicinal honey, native stingless bee honey rates well in relation to antimicrobial properties.

Manuka honey is produced by honey bees foraging on manuka (*Leptospermum*) flowers. Manuka honey contains a powerful antimicrobial agent called methylglyoxal (MGO), which comes from the nectar of *Leptospermum* flowers. However, *T. carbonaria* honey does not contain MGO and stingless bees have not been observed to forage on *Leptospermum* flowers. But stingless honey does contain flavonoids that inhibit microbial growth. These flavonoids probably originate in the resin used by stingless bees to build their honey pots. Alternatively, it may be that microbes in the honey of stingless bees produce substances that inhibit the growth of spoilage microorganisms.

The longevity of the anti-microbial activity honey of *Tetragonula carbonaria* is reasonable, with a loss of only 15% at 28 weeks (Irish, 2008).

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