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Chemical composition of *Moringa oleifera* and Honey from three different Areas in South Sulawesi, Indonesia☆

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ABSTRACT

Objective: The study aimed to assess the composition of MO and honey from different areas in South Sulawesi.
Methods: This was a laboratory examination study. Several macro and micronutrients were measured including water, crude protein, crude lipid, Ca, Mg, Na, P, and K. Also, polyphenol and flavonoid were measured.
Result: The results showed that variation of water, protein, and lipid in MO were 9.2–9.4%, 24.2–29.8%, and 8.43–9.6% respectively. Meanwhile, the variation of Ca, Mg, Na, P, K in MO were 1.63–2.2%, 0.36–0.53%, 0.18–0.43%, 012–0.22% and 0.67–0.76%, respectively. The variation of polyphenol and flavonoid of MO were 0.24–0.34% and 192–209 ppm, respectively. On the other hand, the variation of water, protein, and lipid in different types of honey were 21.1–25.4%, 1.1–1.6%, and 0.01–0.09% respectively. Meanwhile, the variation of Ca, Mg, Na, P, K in honey were 632–1040%, 216–378%, 361–555%, 20–57% and 1570–2848%, respectively. Polyphenol and flavonoids from three different kinds of honey were also varied at 0.06–011% and 14.4–35.8 ppm, respectively.
Conclusion: We conclude that chemical compositions in MO from three areas were almost similar but they were varied enough in honey which was higher in *Trigona* sp.

Introduction

Moringa oleifera (MO) and honey are known to be natural foods that are widely used today. Both of these foods contain various nutrients and active ingredients that can overcome the problem of malnutrition and also improve the nutritional status of the community.[1] Moringa tree is currently known as the miracle tree and has been widely used in various parts of the world.[2,3] MO is a rich source of bioactive compounds with various pharmacological activities.[4] It has been very widely used in the treatment of certain diseases as a traditional medicinal herb.[5] The use of MO and honey has been widely used as complementary medicine for various diseases. One of the obstacles that have been experienced so far is a difference in composition that is different from one region to another.

Several researchers have tried to show differences in the composition of active ingredients in types of MO originating from various regions. Research conducted in Thailand showed that from all provinces in the country, the content of Moringa leaves appears to be the same.[6] On the other hand, studies conducted in Africa from various sources have shown significant differences between regions. This study showed that environmental factors such as temperature and geographical conditions are determinants of the composition present in Moringa leaves.[7,8]

Research related to the variation in honey composition has also been investigated in several studies. Honey from *Trigona* sp. said to contain polyphenols which are much higher than honey produced by *Mellifera* sp. Other studies have also shown that *Trigona* honey has the highest acidity and ash content, in contrast to the lowest reducing sugar and has better content than the existing composition of honey from other bees.[9] Factors related to the composition of honey are type of bee, natural conditions, and source of flowers.[10,11] Other studies have also showed that the quality of honey varies based on plant origin, handling, transportation and storage conditions.[12]

There are no studies that have tried to compare variation of active ingredients in Moringa leaves and honey originating from South Sulawesi region. This study was conducted to assess differences in chemical composition of three Moringa plants from different geographic areas as well as three types of honey from three different regions and bees.

Methods

The study was conducted by taking samples of Moringa leaves and honey from several areas in South Sulawesi Province. Moringa leaves were collected from three different locations which are Jeneponto, Takalar, and Maros Districts. Jeneponto region represents mountainous areas, Takalar region represents coastal areas, and Maros region represents mainland areas. On the other hand,

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Table 1
Proximate test of Moringa leaves.

Variables		Source of Moringa: geographic (district)		
		Mainland (Jeneponto)	Coastal (Takalar)	Highland (Maros)
Water	%	9.34	9.41	9.22
Ash	%	10.10	11.65	10.57
Crude Protein	%	27.82	24.24	29.83
Crude Fat	%	9.56	9.33	8.43

Table 2
Phytochemical test of Moringa leaves.

Variables		Source of Moringa: geographic (district)		
		Mainland (Jeneponto)	Coastal (Takalar)	Highland (Maros)
Polyphenol	%	0.29	0.24	0.34
Total acid	mEq/kg	0.078	0.053	0.070
Flavanoid	ppm	208.51	205.73	191.78
Ca	%	1.63	2.17	2.18
Mg	%	0.46	0,53	0.36
Na	%	0.18	0.43	0.11
P	%	0.15	0.12	0.22
K	%	0.67	0.71	0.76

honey was taken from three different locations including Maros, Gowa, and Sidrap districts. Maros region represents Trigona bee, Gowa region represents Dorsata bee, while Sidrap region represents Mellifera bee.

Moringa leaf samples were taken according to standardized methods, namely, dried Moringa leaves that had been picked and dried at room temperature for a few days. After drying, it is put into a bag and taken to the laboratory. In addition, honey samples directly obtained from bee hunters and put in a closed container and brought to the laboratory.

Laboratory examinations were carried out at the Inorganic Chemistry Laboratory, Faculty of Mathematics and Natural Sciences, Hasanuddin University, Makassar. Examination of water, crude protein, crude fat, and ash levels used proximate test by titration method. On the other hand, examination of micronutrients and phytochemical substances were performed using atomic absorption spectrophotometry (AAS). All examinations are carried out by trained lab staffs.

Result

Results of proximate test of the three Moringa leaves can be seen in Table 1. The moisture, ash, crude protein, and crude fat content of the three types of Moringa leaves were relatively similar. The lowest water content was 9.22%, the lowest ash content was 10.10%, the lowest crude protein content was 24.24%, and the lowest crude fat content was 8.43%. When compared with the highest levels of the three types of Moringa leaves, there were small differences.

Table 2 shows micronutrients and phytochemical substances on three Moringa leaves. Differences between three types of Moringa leaves were relatively small. It was found that the lowest levels of polyphenols were 0.24%, flavonoids were at least 192 ppm, while the minimum levels of calcium, magnesium, sodium, phosphorus, potassium were 1.63%, 0.36%, 0.18%, 0.12%, and 0.67%, respectively.

Table 3 shows proximate tests including water, ash, crude protein, and crude fat content of three types of honey. There were quite varied among the three types of honey, whereas the smallest for water, ash, crude protein, and crude fat were 21.14%, 0.27%, 1.10%, 0.01%, respectively.

Table 4 shows micronutrients and phytochemical substances whereas polyphenols and flavonoids were 0.06% and 14.4 ppm, respectively. In addition, calcium, magnesium, sodium, phosphorus, and potassium, can be seen as a large variation where the minimum was 632 ppm, 216 ppm, 361 ppm, 20 ppm, and 1570 ppm respectively.

We also examined antioxidant in one sample of MO and honey and found that content of honey (Mellifera) was higher than that of MO (highland areas (343 ppm vs. 58 ppm, see Fig. 1). Fig. 1 also showed the differences between highest flavonoid levels in MO and honey whereas higher in MO and honey (209 ppm vs. 39 ppm).

Discussion

This study shows that chemical content in Moringa from three different regions is relatively the same. However, the differences are noticeably detected between bee species under different geographical conditions. The highest content is generally in honey from *Trigona* species from Maros region. Overall, it appears that the bioactive content of ash, crude protein, crude fat, polyphenol, flavonoids as well as micronutrients were higher in Moringa leaves compared to honey. However, antioxidant activities in honey were higher compared to MO.

Differences of active substances of MO in this study are similar to previous studies. A study conducted in Thailand, comparing Moringa leaves that came from several provinces showed that the levels of protein, fat, fibre, moisture, calcium, potassium and iron were relatively similar.[6] However, researchers in Nigeria have also shown that proximate analysis reveals significant differences between different locations for ash, moisture, crude fat, crude fibre, carbohydrate content but no significance for crude protein at different locations.[13]

On the other hand, the results of three types of honey in this study are in line with research conducted in China. The researchers compared the content of honey from China with honey from New Zealand and the result was that buckwheat honey (China) had a higher sugar, protein and total phenol content but lower MGO content than Manuka honey from New Zealand. Buckwheat honey contains many minerals that are involved in a number of vital functions of the human body and has higher levels of Fe, Mn and Zn.[14] Similarly, research in Palestine with 33 honey samples collected directly from honey bee breeders in various geographic areas showed differences.[15]

Research comparing honey from regions with different species was also carried out in Egypt. This study examined 23 honey varieties from Saudi Arabia and six other countries. However, this study showed that there was no significant difference in honey

Table 3
Proximate test of honey bee.

Variables		Type of bee: species (origin of the district)		
		Trigona (Maros)	*Dorsata* (Gowa)	*Melifera* (Sidrap)
Water	%	25.41	23.13	21.14
Ash	%	1.53	2.05	0.27
Crude Protein	%	1.60	1.27	1.10
Crude Lipid	%	0.09	0.02	0.01

Table 4
Phytochemical test of honey bee.

Variables		Type of bee: species (origin of the district)		
		Trigona (Maros)	*Dorsata* (Gowa)	*Melifera* (Sidrap)
Polyphenol	%	0.06	0.08	0.11
Total acid	mEq/kg	0.016	0.004	0.004
Flavanoid	Ppm	35.81	17.55	14.35
Ca	Ppm	1040	616	632
Mg	Ppm	378	260	216
Na	Ppm	555	391	361
P	Ppm	57	36	20
K	Ppm	2352	2848	1570

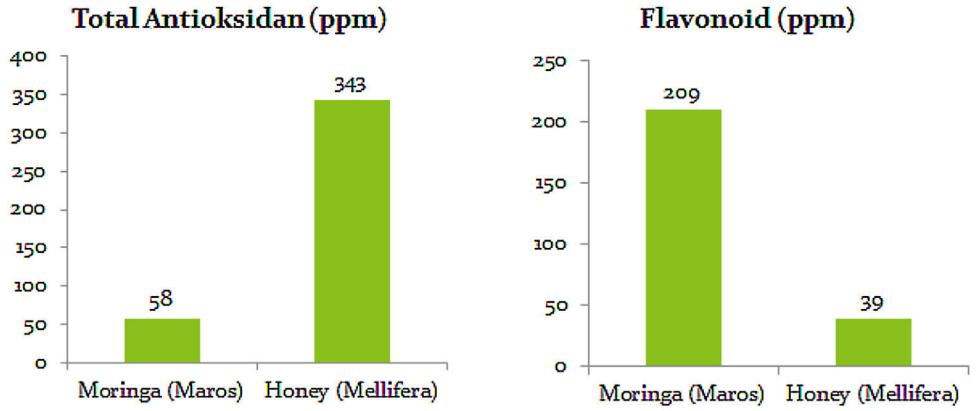

Fig. 1. Differences of total antioxidant and flavonoid in Moringa and Honey.

content between local honey and honey from Egypt, Yemen, New Zealand, Germany, Malaysia and Australia.[16] Other studies have also suggested that the physical-chemical and biological properties of honey are closely related to their flower source, and dark honey such as oak, chestnut, and heather, have high therapeutic potential.[17] In line with research conducted in Thailand with 3 types of bee species, namely *Apis cerana*, *Apis dorsata* and *Apis mellifera* and with different flower sources it will produce honey containing different volatile organic compounds.[10]

This study also showed differences in the nutritional content and phytochemicals in Moringa and honey. Moringa is indeed one of the alternative nutritional supplements that are widely recommended for use in improving nutritional status because of its macronutrient content. Crude protein component up to 30% and crude fat up to 10%. The results of previous studies showed that the content of essential fatty acids in Moringa was indeed very high, as in the study in South Africa which showed that 17 fatty acids were observed with α-linolenic acid (44.57%) having the highest value then followed by heneicosanoic (14.41%), g-linolenic (0.20%) palmiteic (0.17%) and capric acid (0.07%).[18] That is why Moringa has become the choice of nutritional supplements for people suffering from malnutrition.

Unlike Moringa, honey has a mineral content that is much lower. Research conducted in several locations showed that honey is very rich in minerals such as calcium, magnesium, natiritum, and calcium. That is why honey is an excellent supplement for diseases with metabolic disorders such as hypertension, diabetes and stroke. High mineral content will have a major impact on metabolic disorders caused by mineral deficiency. Other studies have also shown that the role of antioxidants in Moringa leaf extract supplements plus honey can improve nutritional status and prevent oxidative stress which has the potential to damage muscle and other tissues.[19] In line with Anna's research in 2015 which shows the results that the antioxidants in Moringa and honey can prevent DNA damage in pregnant women who are passive smokers.[20]

It can be concluded that the composition of Moringa from three different regions, mountains, mainland, and coastal areas, looks similar, while the chemical content in the three types of honey from different bees and regions looks different. Moringa is rich with macro and micronutrients while honey is rich with antioxidants.

Conclusion

We conclude that chemical compositions in *Moringa oleifera* (MO) from three areas were almost similar but they were varied enough in honey which was higher in *Trigona* sp.

Conflicts of interest

The authors declare no conflict of interest.

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