Chemical and Organoleptic Characterization of *Vernonia* Honey

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Abstract–Vernonia amygdalina **honey is one of the important mono-floral honey in Ethiopia where the plant grows widely. In this study Vernonia honey samples were collected from potential honey producing districts of West Wollega, Jimma and Ilu Abba Bora zones of Oromia regional state. Melissopalynological analysis was conducted for the samples to confirm their botanical origin. Aroma and taste were evaluated using blindfold assessment of experienced tasters. Colour was graded using p-fund color grader. Granulation starting time was recorded by inspecting the samples every two days visually and granulation pattern was also judged by close observation of the crystallizing samples. Chemical characterization was conducted following the Codex Alimentarius (2001) protocol. The results indicated that *V.amygdalina* honey is a moo-floral honey with high pollen frequency (mean 84.45%), its peculiar color, aroma, taste and uniform and fine crystallization pattern. The chemical profile generally showed that the honey meets national and international standards: the mean moisture content (18.87%), mean mineral content (0.28%), mean total reducing sugars (70.4%), mean sucrose level (2.03%), mean value of 24.75meq/kg free acidity and mean HMF value of 15.52mg/kg. Therefore, this honey needs due attention so that the beekeepers harvest it and process separately and maintain its natural characteristics to be promoted for improved production and better marketing.**

Key words– **characterization, chemical, honey, organoleptic, *Vernonia amygdalina***

I. INTRODUCTION

Availability and abundance of bee floral plants are important factors for the success of beekeeping [1]. In this regard, Ethiopia has enormous potential as it is endowed with thousands of species of honeybee flora [2]. These plants include trees in forests, bushes, grasses and numerous cultivated crops that can support large number of honeybee populations. Most of these plants supply nectar or pollen or both [3]. Some of the honeybee plants are major ones and are dominantly used by the bees for brood rearing and honey production, while the rest are minor ones.

The plant, *Vernonia amygdalina* Del., belongs to the family called Asteraceae. It is a bush usually branched from near the base and growing up to 10m high; with rough bark, longitudinally fissured. The young branches have numerous white breathing poles. The leaves are alternate, elliptic-lanceolate or obolanceolate with regularly toothed margins. The flowers are white, tinged purple or pink arranged in numerous heads at the ends of the branches [2]. *V. amygdalina* is native to more than 34 African countries including Ethiopia. It is widely distributed in wide range of bush land, woodland and forest habitats between 1200 and 3000 m. a. s. l. in almost all floristic regions [2], [4]. The species also successfully grows in secondary forests, roadsides, wastelands and often found in the premises of backyard gardens. It requires an annual rainfall of 750 mm to 2000 mm.

V. amygdalina is widely used as a hedge-forming shrub and as a boundary marker. The plant has so many medicinal values for both human and livestock diseases treatment. The leaves and barks are locally used against diarrhea [5]; menstruation pain, as a purgative febrifuge, in wound dressing and against urinary inflammations [6]. *V. amygdalina* leaf is used widely as supplementary feed for animals particularly cows and sheep [7], [8]. Besides, the leaf has been described for its strong anti-helminthic property [9].

Honeybees collect both nectar and whitish pollen from this plant that flower mostly during December to end of January and the honey from these plants is harvested from end of January to end of February [4]. However, in areas where there are no other flowering plants during this season bees face severe shortage of food and this plant serves as supplementary forage to sustain colonies. The Southern, southwestern and Western parts of Ethiopia has tremendous potential of *V. amygdalina* honey and beekeepers harvest significant amount of it [10], [11]. Traditionally, "*vernonia*" honey is believed to have medicinal value, and hence fetches a better price than other honey types. Vernonia honey is harvested and marketed as mono-flora and special honey for its dark colour and strong and unique aroma [2], [10]. However, the physical and chemical content of this honey has not been studied yet. Therefore, this paper attempted to characterize the chemical and organoleptic properties *V. amygdalina* honey collected from the above mentioned regions of the country.

II. MATERIALS AND METHODS

A. Honey Sample Collection

Honey samples were collected from potential vernonia honey producing zones in Oromia Regional State with the consultation of district beekeeping experts, experienced beekeepers and honey dealers. A total of 36 honey samples, each weighing a minimum of 500gm were collected from major *V. amygdalina* honey producing areas (West Wollega, Jimma and Ilu Abba Bora Zones). In most cases the honey samples were collected from beekeepers

during honey flow period and where beekeepers were not accessible honey samples collected from local markets ("*mar berendas*") were used.

B. Straining Honey Samples

The honey samples were first strained using double sieves and cheese cloth in honeybee product laboratory of Holeta Bee Research Center to separate the pure honey from the wax and other impurities after moderately warming using water bath system. The purified honey samples were stored in a refrigerator at 4^{o}C until any laboratory analysis.

C. Melissopalynological Analysis

Determination of botanical origin of honey samples were conducted using [12] method. The honey source plants were identified using documented pollen references. Since vernonia honey is among high pollen grain loaded honey types [10], only honey samples of more than 80% of the vernonia pollen grains count were considered for further analysis and observations. Accordingly, only 24 honey samples, eight from each zone were further analyzed.

D. Chemical Analysis

Parameters like: moisture content, total reducing sugars, sucrose, hydroxy methylfurfural (HMF), mineral content and acidity were investigated for 24 honey samples that have qualified to contain more than 80% pollen count of *V. amygdalina* in food laboratory of Ethiopian Conformity Assessment Enterprise following Codex Alimentarius 2001 protocols [13].

E. Organoleptic Characterization

Organoleptic properties such as taste, smell, colors and nature of granulation were conducted in the honeybee product laboratory of HBRC. Sensory evaluation of taste (bitter or sweet) and aroma (strong or weak or absent) were done by using five experienced staff of HBRC as panelists served against checklist pre-prepared. The color of the honey samples were measured using Koehler P-fund color Grader No. 0061 when they were in liquid state after pouring about 100gm of honey into the sample holder of p-fund grader.

F. Granulation

Honey samples still in liquid state were poured in 0.5kg honey jar and set for observation in a room temperature condition in Bee products laboratory, Holeta Bee Research Center. The rate at which crystallization took place and pattern and texture of granulation (coarseness, fineness, irregularity, uniformity and layer formation) were documented using checklist for consecutive six months. Data were recorded for the onset of granulation and pattern of the granulation visually at every two days interval [14].

G. Statistical Analysis

The data were analyzed by using ANOVA of SAS 2002 software.

III. RESULTS AND DISCUSSION

A. Melissopalynological Analysis

Based on melissopalynological analysis, *V. amygdalina* honey is one of the mono-flora honeys with pronounced pollen representation. The pollen analysis of the sample honeys shows pollen count of *V. amygdalina* ranges from 75.8 to 89.2%, means of 84.45%. This finding is in consent with previous results reported by different authors [10], [15]. In most of the honey samples pollen grains of *Coffee arabica* were observed, with varying representation. This is mainly from the fact that not only *V. amygdalina* and *C. arabica* have similar ecosystems, but also these two species have very close flowering calendar. So, it is likely honey from both plants can be harvested altogether [2], [11]. The highest representation of *C. arabica* pollen grain was as much as 21.4%, from honey samples collected from West Wollega.

B. Chemical characterizations

Based on the test results the moisture content of the *V. amygdalina* honey samples ranged from 16.6 - 21.2% with mean of 18.87% (Table 1). This is generally in consent with previous reports and also meets the standards of moisture content set for Ethiopia and international table honeys and various reports from different region of the country [10], [15], [16], [17], [18], [19]. Generally the moisture content of the honey was low, which might be due to the fact that the honey from this plant is harvested around February to March when the atmospheric relative humidity is relatively lower that might contribute to the lower moisture content of this honey [2], [11]. [20] reported that honey types from southwestern areas of SNNP which are very humid regions has moisture content as high as 22.9%, though did not indicate the botanical sources.

The mineral contents of the tested honeys ranged from 0.07 - 0.65% with mean of 0.28% by mass and it was also within honey standards. Generally speaking honey samples in this study and other previous reports indicated that the ash content showed big variations even though the mean value always fell in the range of national and international standards [10], [17], [18], [19], [20], [21]. The big difference in mineral content might be due to the variation in geographical source of the honey samples as soil type is one of the factors to influence ash contents of honey, in addition to the botanical origin and other environmental factors [22].

The total reducing sugars of these honeys were between 64.45 and 79.13% with mean of 70.74% (Table 1). This result showed that the total reducing sugar of the honey samples meet the table honey standards. The upper value of the reducing sugars observed in this investigation is higher than reported for most of the honey types in Ethiopia [15], [17], [18], [19], [20], [21]. However, [23] indicated that both fructose and glucose of some honey samples reached about 80%, that is almost the same to the upper range observed in this study.

The mean value of sucrose of *V. amygdalina* honey samples ranged from 0.55 - 4.9% with mean of 2.03% (Table 1). It is very comparable to the sucrose content reported by [21] for Harena forest honey, honey from Tigray [18] and from Sheka Zone [20] but is lower than the maximum limits set by IHC 2002 [24] and the Ethiopian average that is 3.6g, reported by [17]. Mean sucrose content as high as 7.55% was reported for honey samples collected from Gondar area [19].

The mean free acid content of the *V. amygdalina* honey samples was 24.75 meq/ kg (18.2 -34.27 meq/ kg), table 1. This mean value is very close to what had been reported for this honey type by [10]; but far lower than what had been reported for unspecified honey types from different regions and the overall Ethiopian national standards without specifying its botanical source [17], [21]. This results showed that this honey has very desirable acidity level compared to the Ethiopian and the EU (<40meq/kg), CA (<50meq/kg) requirements as low acid value is an indicator of low fermentation, which deteriorates the quality of honey [25].

The HMF amount of the sampled honeys varied from 2.5 -37.46 mg/kg with mean of 15.52mg/kg (Table 1). Previous studies by [21] and [19] indicated very low HMF mean value of honey from Bale (0.84 mg/kg) and Gondar area (6.32 mg/kg), respectively. However, 19.52 mg/kg was also reported from honey samples collected from Sheka zone of SNNPRS [20]. These reports did not specifically indicate the botanical sources of the honey samples and the age of the samples after harvesting that has significant effect on the HMF values [26].

TABLE I. Pollen Grain Frequency And Chemical Properties Of *V. Amygdalina* Honey Samples Collected From West Wollega, Jimma And Ilu Abba Bora Zones And Their Comparison With Ethiopian National Honey Standard.

Parameters	Mean + SD	Range	Ethiopian standards
Percentage of pollen	84.45±9.24	75.8 - 89.2	-
Moisture content (g/100g)	18.87±1.14	16.6 - 21.2	17.5 - 21
Mineral content (g/100g)	0.28±0.16	0.07 - 0.65	< 0.6
Total reducing sugars (g/100g)	70.4±6.93	64.45 - 79.13	> 65
Sucrose (g/100g)	2.03±1.12	0.55 - 4.9	< 5
Acidity meq/1000g	24.75±12.41	18.2 -34.27	< 40
HMF (mg/1000g)	15.52±11.55	2.5 -37.46	< 40

C. Organoleptic characteristics

The visual observation and instrumental colour assessment of *V. amygdalina* honey indicates that this honey is very dark in colour. The value of P-fund honey colour grader scale ranges from 11.9 to 13.5. The dark colour persists even after crystallization, unlike most of honey types in Ethiopia which turn lighter after crystallization than when they were in liquid state [10]. The flavour of this honey is characterised by strong and pleasant aroma and peculiar bitter taste.

In this study the minimum time for the onset of granulation was visually observed on the 126th day since monitoring was started. *V. amygdalina* honey granulates very gradually with fine and uniform crystallization pattern. This fine and uniform pattern of granulation makes this honey to be easily spread on bread for table consumption. Granulation is a natural process for all types of honey due to the presence of supersaturating sugars; the rate of granulation, however, is influenced by level of water content, presence of crystal forming nuclei, degree of supersaturation and viscosity [27], and storage temperature [13], [28].

IV. CONCLUSIONS

This study clearly showed that *V. amygdalina* honey has distinct chemical and organoleptic properties that make it very desirable, especially for table consumption. In terms of all the chemical parameters tested, it meets all the Ethiopian and IHC 2002 standards [24]. In fact, the average of the most of the quality measurements of this honey is by far better than the national and international standards. This is may be due to the fact that these national and world standards are based only on geographical and/or boundary contexts and not specific to botanical sources of the honey.

Based on the pollen analysis results from previous and this study, *V. amygdalina* honey is important mono-floral honey. Therefore, capacity building in terms of awareness creation and skill to produce, separately harvest, store and process this mono-floral honey has to be considered seriously by all stakeholders. Moreover, it is important to brand and promote this honey in all available markets to generate more income.

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