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CLASSIFICATION OF TURKISH HONEYS FROM AYDIN-KARACASU-DIKMEN VILLAGE BASED ON MELISSOPALYNOLOGICAL PARAMETERS

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ABSTRACT. The classification of Aydın -Karacasu-Dikmen honeys was practised based on melissopalynological parameters. A total of 65 honey samples from Aydın-Karacasu-Dikmen village located in Aegean Region of Turkey were collected during the 2018-2019 harvesting season. According to the melissopalynological results, 54 samples were determined as nectar (blossom), seven as honeydew honey and four as mix of nectar and honeydew honey (blend honey). In all the honey samples *Thymus spp*. pollens were observed. Also sensory analysis were done for the investigated honey samples. As a result, owing to *Thymus spp*. pollen contents in all the samples the aroma and the odour of Thymus were detected by sensory analyses. The honey types of the region were determined according to the botanical sources exhibited by the research.

1. INTRODUCTION

According to the Codex Alimentarius (Codex STAN 12-1981) and the European Union Legislation (2001/110/EC) “honey; is natural sweety substance produced by honeybees from the nectar or secretion of living parts of plants, or excretions of plant-sucking insects on the living parts of plants. Then the bees add their own specific substances, deposit, dehydrate, store and leave in the honeycomb to ripen and mature. Floral or nectar honey is made by honeybees from the nectar of blossoms, while honeydew honey is sourced from secretions of living parts of plants or exrections of plant-sucking insects on the living parts of plants [1].

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Melissopalynological analysis is a kind of method to determine the botanical source of the honey. Honey generally comprises so many pollen grains and honeydew elements (HDE; hyphae, fungal spores) that give an information about the source of honey. Quantitative and qualitative analysis of particules (pollen and honeydew elements) can be a step for characterization of honey group (as blossom or honeydew honey) and also type of blossom honey (monofloral, multifloral) [2]. Besides melissoplaynologcal analysis, physicochemical analysis are also necessary for certain results of botanical origin [3]. Knowing the botanical source of honey provides quality and economic value and also gives information to the consumer. Cause honey has beneficial properties depend on the floral sources, which improve human health [4].

The chemical composition of honey is variable, owing to the differences in plant types, climate, environmental conditions, and harvesting [5]. Its main components are carbohydrates, water, organic acids, enzymes, amino acids, pigments, pollen and wax; some are added by the bees and some of them are sourced from the plants [6]. Compare to nectar honeys, honeydew honeys are generally differentiated from nectar honey by higher values of pH, acidity, ash, electrical conductivity and lower monosaccharide content [7]. Moisture content is also an important criteria and determines the capability of honey to remain stable in storage without fermentation. Generally, a maximum moisture content of 21 g/100g honey is suggested [8]. Total phenolic acid content is another parameter to determine the quality of honey, owing to their antioxidant activities. These compounds have been used as chemotaxonomic markers in plant systematics; dark coloured honeys are reported to contain more phenolic acid derivates but less flavonoids than light colour ones [9].

Testing honey adulteration can be done by analyzing different physicochemical parameters like melissopalynological, sensory analysis, sugar and amino acid contents, enzyme activities. Owing to its geographical location, floral richness and climatical conditions, Turkey has a great potential for beekeeping. The production ratio of Turkish honey has been 114 471 tons in 2017. As well as, Aegean Region has an important role on the development of Turkish beekeeping. Cause it has the highest honey production compare to the other regions with a ratio 22.8% of the total [10]. Due to the floristic structure, in this region both honeydew and nectar honeys have been producing for many years now. Despite the high honey production potential of the Aegean region, the melissopalynological and physicochemical characteristics have not been researched together exhaustively. The researches about the region are mostly based on honeydew honeys.

The first aim of this study was to determine the honey types producing in Aydın-Karacasu-Dikmen village of Turkey. Secondly, characterize the identified honey types according to their botanical sources. In connection with, there is no any detailed data about the honey of research area, the results will be a data source for the region and will be useful for the characterization of different types honey.

2. Materials and Methods

2.1. Sampling

A total of 65 honey samples were collected from different beehives of the region (from Dikmen and Yeniköy villages), that has a rich plant cover for beekeeping. All the samples were collected during the year 2018 and 2019 period. Samples were stored at room temperature until the analysis.

2.2. Melissopalynological analysis

Microscopic analysis were done by qualitative and quantitative. Microscopic slides were prepared for melissopalynological analysis according to the method described by Louveaux et al. (1978) [11]. Besides the determination of botanical origin, the total pollen number in 10 g honey (TPN10) of all samples was calculated according to the method described by Moar et al. (1985) [12]. The honey samples were classified according to Maurizio's classification (1975) as Group I (<20.000) pollen grains per 10 g honey), Group II (20.000-100.000 pollen grains per 10 g honey), Group III (100.000–500.000 grains per 10 g honey), Group IV (500.000 –1000.000 grains per 10 g honey) and Group V (>1.000.000grains per 10 g honey) [13]. The honeydew elements (HDE) consist of fungal spores and hyphae were also recorded during the microscopic investigation for specifying honeydew honeys.

2.3. Physicochemical analysis

Moisture

Moustire analyses were done according to the Honey Product Inspection Manual of Canadian Food Inspection Agency (2012) by a non-digital refractometer and the results defined as % (w/v) ratio [14].

2.4. Sensory analysis

Sensory analysis were done according to the Marcazzan et al. (2018) [15]. The assessors evaluated the honey samples according to their colour intensity, odour intensity, sweetness, aroma and crystallisation rate.

3. Results

3.1.Melissopalynological characteristics

According to the melissopalynological results, in the 65 investigated honey samples, the pollen belong to the taxa of Asteraceae, Apiaceae, Betulaceae Brassicaceae, Boraginaceae, Campanulaceae, Caryophyllaceae, Chenopodiaceae, Cistaceae, Cyperaceae, Dipsecaceae, Euphorbiaceae, Fabaceae, Fagaceae, Geraniaceae, Lamiaceae, Liliaceae, Malvaceae, Myrtaceae, Oleaceae, Plantaginaceae, Poaceae, Polygonaceae, Portulaceae, Ranunculaceae, Rosaceae, Rubiaceae, Salicaceae and Scrophulariaceae families were identified. According to the melissopalynological results, honey samples divided into three groups; nectar honey (it is also divided as monofloral; Generally, a honey is considered as coming predominantly from a given botanical origin (unifloral –monofloral honey) if the relative frequency of the pollen of that taxon exceeds 45%. This ratio is; 13-68% for Thymus honey and >86% for chesnut honey, also from other plants in lower ratios and multifloral; sourced from various plant species, it has no any dominant species), honeydew honey (honeydew if the ratio of the number of honeydew elements (HDE) to that of pollen grains (PG) exceeds 3. [3]), compound honey (mix of honeydew and blossom honey). Main pollen identified in honey samples are given in the Table 1-5 and the classifying of the honey samples according to their TPN10 and HDE10 values are given in the Table 6. 54 of the samples were evaluated as nectar honey (multifloral;H3,5,6,8,15,21,23,24 and monofloral; H13: *Centaurea*, H25: Oleaceae, H4,7,20,22,26: *Thymus, H27-37 and H39-65: Astragalus sp., H38-2019: chesnut*), seven of them as honeydew honey (H9,10,11,12,16,18,19) and four as blend honey (H1,2,14,17). By this analysis a new type of honey; *Centaurea* honey was also identified. Also in all the investigated samples *Thymus* spp. pollen were observed in different ratios. Honeydew honey samples were probably sourced from *Pinus brutia* with contribution of Brassicaceae, Boraginaceae, Fabaceae, Lamiaceae, Plantaginaceae and Ranunculaceae.

TABLE 1. The ratios of the pollen of plant taxa identified in honey samples (%) (H1-15).

Plant family	Plant taxa	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15
Asteraceae		4	3,5	3,73	3,99	0,40	1,1	0	0,8	0	0	5,8	6,25	4,4	0,99	0,60
	Centaurea aphrodisea	0	0,96	26,86	23,65	16,39	0	31,75	19,65	6,73	20,45	9,80	6,25	62,68	10,89	31,70
	***Centaurea* sp.**	0	0	0	0	0	5,55	0,97	0	0	0	0	0	0	0	0
	Centaurea urvillei	0	0	0	0	0	0	0	1,74	0	0	0	0	4,47	0,99	0
	***Taraxacum* sp.**	4	0,96	0,74	7,01	0,40	0,55	6,35	3,49	1,03	25	7,84	3,12	2,98	0	0
Apiaceae		0	1,6	0	0,10	0,40	0,55	0,48	0	0,51	0	1,96	6,25	0	0	0
Brassicaceae		8	8,6	3,73	8,85	3,27	0,55	2,44	10,48	19,68	4,54	3,92	0	0	2,97	4,26
Boraginaceae		8	5,46	0,74	0,86	2,45	10	0	0,87	0	2,27	5,88	21,87	0	0,99	18,29
	***Alkanna* sp.**	0	0	0	0	0	0	0,16	0	0	0	0	0	0	0	0
	***Echium* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,60
Campanulaceae		0	3,2	1,11	0,64	0,40	0,55	0	0,43	0	0	0	0	0	0	1,21
Caryophyllaceae		0	0	2,23	0,64	1,63	0	0	1,74	0	0	0	0	0	0	1,21
Chenopodiaceae		0	1,2	0,37	0,75	0	10,55	0	0	0	4,54	3,92	18,75	0	0,99	0,60
Cyperaceae	***Carex* sp.**	0	0	0,37	0	0	0	0	0	0	0	0	0	0	0	0
Dipsecaceae		0	0	0,37	0	0	0	0	0	0	0	0	0	0	0	0
	***Scabiosa* sp.**	0	0	0	0,97	0	0	0	0	0,51	0	0	0	0	0	0
Fabaceae		28	33,44	19,02	10,69	29,91	31,66	13,35	16,59	10,88	20,45	17,64	15,62	7,46	41,58	6,09
	***Astragalus* sp.**	0	2,25	1,11	0	3,27	4,44		1,3	1,55	0	0	0	0	0	0
	***Onobrychis* sp.**	0	0,32	0	0	0	0		0	0	0	0	0	0	0	0
	***Trifolium* sp.**	4	0	0	0	0	0	8,30	3,49	5,6	2,27	0	0	5,97	2,97	7,92
	Trifolium pratense	0	0,64	2,23	0	0	0	0	0	0	0	0	0	0	0	0
	Trifolium repens	0	8,36	11,19	7,12	15,57	9,44	0	0	0	0	0	0	0	0	0
	Vicia sp.	0	0	0	0	0,40	0	0,48	0	3,10	0	0	0	0	0	0
Lamiaceae		4	6,75	4,10	2,26	0,40	3,88	0	3,49	1,55	4,54	11,76	3,12	0	0,99	0,60
	Teucrium montanum	0	0	3,35	2,59	2,45	0	1,95	2,62	2,0	0	0	0	0	0	4,87
	Teucrium polium	0	0	0	0,86	0	0	2,44	7,42	8,29	4,54	0	3,12	0	0	0
	Thymus leucotrichum	8	10,61	8,95	18,35	7,37	6,66	18,07	5,67	12,4	4,54	5,88	3,12	8,95	0	6,09
	***Thymus* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	0	32,67	10,97
Liliaceae		0	0	0	0,97	0	1,11	0,97	0	0	0	0	9,37	0	0	0
Malvaceae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oleaceae		0	0,32	0	0,21	0	0	0	0,43	0	2,27	0	0	0	0	0
Plantaginaceae	***Plantago* sp.**	8	0,64	2,61	3,34	0,40	0,55	0,97	0,43	3,10	0	19,60	3,12	1,49	0	0
Ranunculaceae		0	2,25	0	0	0	0	0	0	19,17	0	0	0	0	0	0
Rosaceae		4	3,5	1,49	2,05	1,63	2,7	2,2	0,43	0,5	0	1,96	0	0	1,98	0,60
Rubiaceae	***Galium* sp.**	0	0	0,74	0,32	0	0,5	0	0,436	0	2,27	1,96	0	0	0	0
Salicaceae	***Salix* sp.**	12	5,1	4,85	3,67	13,11	3,88	6,35	18,34	3,10	2,27	1,96	0	1,49	0,99	4,26

Dominant pollen (over 45%), secondary pollen (16-45%), minor pollen (1-15%); trace pollen (less than 1%) Dominant pollen for Thymus spp. (13–68%) for Castanea sativa (> 86%)

TABLE 2. The ratios of the pollen of plant taxa identified in honey samples (%) (H16-26).

Plant family	Plant taxa	H16	H17	H 18	H19	H 20	H21	H22	H23	H 24	H25	H26
Asteraceae		1,26	0	2,17	4,02	5,33	3,07	4,78	0,96	0,33	0	4,25
	***Carduus* sp.**	0	0	0	0	0	0	0	0	0	1,75	4,25
	Centaurea aphrodisea	19,19	11,90	6,52	1,72	3,91	21,53	9,57	31,25	7,87	1,22	0
	***Taraxacum* sp.**	20,20	2,38	2,17	5,74	7,82	1,53	0	0	0	0	0
Apiaceae		0,25	0	0	0,28	1,067	0	0	0	0	0	0
Brassicaceae		0,25	7,14	0	0	0,71	9,23	0	0	0	0	0
Boraginaceae		6,06	9,52	52,17	28,44	21,35	1,53	0	1,44	0	20,74	0
Campanulaceae		0	0	0	4,02	0,71	0	0	0	0	0	4,25
Caryophyllaceae		0	0	0	0	0	0,76	0	11,53	3,88	0	0
Chenopodiaceae		3,53	4,76	6,52	0	0,35	0	0	0	0	0	8,51
Cyperaceae	***Carex* sp.**	0	0	0	0	0	0	0	0	0	0	2,12
Dipsecaceae		0	0	0	0	0	0	0	0	0	0	4,25
	***Scabiosa* sp.**	0	0	0	0	0	0	0	0,48	0,34	0	0
Fabaceae		19,69	19,04	6,52	10,91	25,97	6,92	28,71	17,78	64,98	0,81	0
	***Astragalus* sp.**	0	0	0	0	0	3,076	4,57	2,40	0	0	6,38
	***Trifolium* sp.**	1,51	14,28	6,52	0,86	0	3,84	0	10,09	0	0	0
Lamiaceae		0,25	0	0	0	0	0	0	0	0	0,65	0
	Teucrium montanum	0,50	0	0	0	0	2,30	0	7,69	3,72	0	0
	Teucrium polium	1,01	2,38	4,34	0,57	1,42	4,61	0	0,48	0	0	0
	Thymus leucotrichum	2,77	7,14	13,04	12,64	**18,14**	6,15	4,72	6,73	7,37	0,39	8,51
	***Thymus* sp type I**							9,2		3,8		
	***Thymus sp*. type II**	11,61	2,38	0	6,03	1,06	0	**33,50**	3,84	12,32	0	**36,17**
Liliaceae		4,54	0	0	0,57	1,06	0	0	0	0	19,52	0
Malvaceae		0	0	0	0,28	0	0	0	0	0	0	0
Myrtaceae	***Eucalyptus* sp.**	0	0	0	0,28	0	0	0	0	0	0	0
Oleaceae		2,02	0	0	22,41	4,98	0	0	0	0	**54,48**	0
Plantaginaceae	***Plantago* sp.**	1,010	0	0	0	0,35	0,76	0	0,96	0	0	2,12
Portulacaceae	***Portulaca pilosa***	3,03	0	0	0,28	0	0	0	0	0	0	17,0
Ranunculaceae		0	0	0	0	0	2,30	0	0	0	0	0
Rosaceae		0,25	2,38	0	0,57	2,49	3,84	4,49	2,88	3,55	0	0
Rubiaceae	***Galium* sp.**	0,50	0	0	0	0,71	0	0	0,96	0	0	0
Salicaceae	***Salix* sp.**	0,50	16,66	0	0,28	2,49	28,46	0	0,48	0	0,40	2,12

TABLE 3. The ratios of the pollen of plant taxa identified in honey samples (%) (H27-41).

Plant family	Plant taxa	H27	H28	H29	H30	H31	H32	H33	H34	H35	H36	H37	H38	H39	H40	H41
Asteraceae	*Centaurea* sp.	0	0,5	0,5	0	0,5	1,5	0	0,5	0	0	0	0	0	0	2
	Cichorium sp.	0,5	0	0	1	0	0,5	0	1	0	0	1	0	0	0	0
Brassicaceae		0,5	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0
Boraginaceae		0,5	0,5	0	0,5	0	0	0	0	0	0	0	0	0	0	0
	Echium sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0
Campanulaceae		0	0,5	0	0	0	0	0	0	0,5	0	0	0	0	0	0,5
Caryophyllaceae		0	1	0	0	0	0	1	0	0	0	1	0	0	0	1
Chenopodiaceae		0	0	0	0	0	0	0	0,5	0	0	0	0	0	0	0
Cistaceae		0	0,5	1	1	1	0	0	1	1,5	1	1	0	0,5	1	0
Cyperaceae	*Carex* sp.	0	0	0,5	0	0	0	0	0	0	0	0	0	0	0	0
Dipsecaceae	*Scabiosa* sp.	0	0	0	0,5	0	0	0	0,5	0	0,5	0	0	0	0	0
Fabaceae		0	0	0	0	0	0	0,5	0	0	0	0	0	0	0	0
	Astragalus sp.	90	83	93	85,5	92,5	87,5	86,5	81,5	75	81	87	13	93	83	82,5
	Onobrychis sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0,5	0
	Trifolium sp.	0	0	0	0,5	0	0	0	1,5	1	2	3,5	0	0,5	0	2
	Lotus sp.	0,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medicago sp.	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0,5	0
	Vicia sp.	0,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fagaceae	*Castanea sativa*	0	0	1	1	1	0	2	1	8,5	-	0,5	85	1	1	5
Lamiaceae																
	Teucrium sp.	1	0	1	0,5	0	2	0,5	1	0,5	2	0	0	1	4	0,5
	Thymus sp.	5	8	1	4,5	3,5	4	5	4,5	7,5	9	3	1	1,5	3,5	3,5
Liliaceae		0	3,5	0,5	1,5	0	2,5	0	3	1,5	2,5	1	0	0	4	0
Plantaginaceae	*Plantago* sp.	0	1,5	0,5	0	0	0,5	2	1,5	1,5	1,5	1,5	0,5	1	0,5	0
Polygonaceae	*Rumex sp.*	0	0	0	0,5	0	0	0	0	0	0	0	0	0	0	0
Rosaceae		1	2	1	2	1	1,5	2	1,5	2	1	0,5	0,5	0,5	2	2
Rubiaceae	*Galium* sp.	0	0	0	0	0,5	0	0	0	0	0	0	0	0	0	1
Salicaceae	*Salix* sp.	0	0	0	0	1,5	0	0,5	1	0,5	0	0	0	0,5	0	0

TABLE 4. The ratios of the pollen of plant taxa identified in honey samples (%) (H42-56).

Plant family	Plant taxa	H42	H43	H44	H45	H46	H47	H48	H49	H50	H51	H52	H53	H54	H55	H56
Asteraceae	*Artemissia* sp.						0,5									
	Centaurea sp.	0	1,5	0,5	0	1,5	0	0	0,5	0	0,5	0,5	0	0	0	0
	Cichorium sp.	0,5	0,5	1	0	0	0	0	0	0	0	0	0	0	0	0
	Taraxacum sp.	0	0	0	0	0,5	0	0	0	0,5	0,5	0	0	0,5	0	0
Betulaceae														1,5		
Brassicaceae									0,5	0	0	0,5	0,5	0,5	0	0
Boraginaceae	*Echium* sp.							0,5								
Campanulaceae			1													
Caryophyllaceae		0,5	1									0,5	0,5			
Cistaceae		0,5	0	1	1,5	0	1	0	0	0	0	1,5	0	2	1	0,5
Cyperaceae	*Carex* sp.			2									1,5	1,5		
Dipsecaceae	*Scabiosa* sp.			0,5								0,5	0	0,5		
Euphorbiaceae	*Euphorbia sp.*					0,5										
Fabaceae	*Astragalus* sp.	85,5	83	85	91	84,5	86	89	86,5	88,5	89,5	86,5	88	76	85	91,5
	Onobrychis sp.											0,5				
	Trifolium sp.	2,5	1	1												
	Lotus sp.	0	0	0	0,5	1,5	0	1,5	4	1,5	1	0,5	0	2,5	3,5	1
	Vicia sp.	0	0,5	0	0	2	1	0	0,5	0	0,5	0	0	0	0	0
Lamiaceae																
	Teucrium sp.	0	0,5	1												
	Thymus sp.	6	7	4	5	4,5	6,5	5,5	4	6	5	4	5,5	6,5	4,5	3,5
Liliaceae		1,5	1	2	0,5											
	Allium sp.						1	2	2	1,5	0,5	0,5	1	3	3,5	1,5
Plantaginaceae	*Plantago* sp.	1	0,5	0	0	0,5	0	0,5	0,5	0,5	0,5	0,5	0,5	4,5	1,5	0,5
Poaceae						1	1								1	
Polygonaceae	*Rumex sp.*										0,5					
Rosaceae		2	0,5	1,5	1	2,5	3	1	1,5	0,5	0	1,5	2	0,5	0	0,5
Rubiaceae	*Galium* sp.	0	0	0	0,5							0,5				
Salicaceae	*Salix* sp.			0,5							1	1	0	0,5	0	0,5
Scrophulariaceae	*Linaria sp.*					1	0	0	0	0,5	0,5	1	0,5	0	0	0,5

TABLE 5. The ratios of the pollen of plant taxa identified in honey samples (%) (H57-65).

Plant family	Plant taxa	H57	H58	H59	H60	H61	H62	H63	H64	H65
Asteraceae	*Centaurea* sp.						1	0	0,5	
	Taraxacum sp.	0,5	0,5						1	
Boraginaceae	*Heliotropium* sp.			0,5						
Caryophyllaceae			1,5	1						0,5
Cistaceae		1	0	2	0,5	1,5	1	0	0,5	0,5
Cyperaceae	*Carex* sp.			0,5	1	0,5				
Dipsecaceae	*Scabiosa* sp.	0,5						0,5	0	0,5
Fabaceae	*Astragalus* sp.	88,5	85,5	83,5	88,5	87	89,5	87,5	84	90
	Lotus sp.	2,5	1,5	1,5	1,5	0	1,5	1,5	1	0,5
Geraniaceae	*Geranium sp.*	0	0	1						
Lamiaceae	*Thymus* sp.	2,5	5	6,5	4	6	3	4	5,5	3,5
Liliaceae	*Allium* sp.	2,5	3	1,5	0,5	1,5	2,5	2,5	3,5	2,5
Myrtaceae	*Eucalyptus* sp.								0,5	
Plantaginaceae	*Plantago* sp.	0,5	1,5	0,5	2,5	1	0,5	0,5	0,5	1
Poaceae	*Zea mays*					0,5				
Polygonaceae	*Rumex sp.*	0	0,5							
Rosaceae		1	0	1	1,5	1,5	1	2,5	2	1
Salicaceae	*Salix* sp.	0,5	0	0	0	0,5	0	1		
Scrophulariaceae	*Linaria sp.*	0	1	0,5					0,5	

TABLE 6. TPN10, HDE10 values and sources of honeys.

Honey sample	TPN_{10}	Maurizio's classification	HDE_{10}	HDE10/TPN10	Source of honey	Type of honey	Moisture
H1	2416,5	Group I	6,867,947	2,842,105	Multiflower-,honeydew	Blend	17
H2	79 151,77	Group II	180796,8	2,284,178	Multiflower-honeydew	Blend	16.4
H3	40 354,98	Group II	30620,43	0,758777	Multiflower	Nectar	17.3
H4	63 387,39	Group II	4,621,195	0,00729	Monoflower	Nectar	18.4
H5	61 768,1	Group II	13485,25	0,218321	Multiflower	Nectar	17.4
H6	81 48,915	Group II	12570,13	1,542,553	Multiflower	Nectar	16.4
H7	19 237,7	Group I	-	-	Monoflower	Monofloral	17.5
H8	17 452,5	Group I	-	-	Multiflower	Nectar	17.6

Honey sample	TPN_{10}	Maurizio's classification	HDE_{10}	HDE10/TPN10	Source of honey	Type of honey	Moisture
H9	3 383,1	Group I	364891,5	1,078,571	Honeydew	Honeydew honey	18.4
H10	63 90,744	Group II	42338,68	6,625	Honeydew	Honeydew honey	15.7
H11	5 928,48	Group I	59284,8	10	Honeydew	Honeydew honey	17.4
H12	1 364,612	Group I	133049,6	97,5	Honeydew	Honeydew honey	17.3
H13	11 011,9	Group I	11827,59	1,074,074	Monoflower	Nectar	16.9
H14	11 288,76	Group I	27798,57	24,625	Honeydew, multifower	Blend	17
H15	30 902,98	Group II	6,349,927	0,205479	Multiflower	Nectar	17.7
H16	14 629,62	Group I	108154,7	7,392,857	Honeydew	Honeydew honey	16
H17	82 23,771	Group II	15895,2	1,932,836	Honeydew, multiflower	Blend	16.9
H18	44 81,509	Group II	55799,18	1,245,098	Honeydew	Honeydew honey	16.3
H19	27 064,8	Group II	111352,3	4,114,286	Honeydew	Honeydew honey	19.8
H20	18 160,36	Group I	18863,35	103,871	Monoflower	Nectar	14.4
H21	23 474,57	Group II	8,787,273	0,374332	Multiflower	Nectar	15.6
H22	208 297,9	Group III	-	-	Monoflower	Nectar	16.5
H23	28 664,69	Group II	-	-	Multiflower	Nectar	17.9
H24	79 0854,5	Group II	-	-	Multiflower	Nectar	17.3
H25	278 380,8	Group III	-	-	Monoflower	Nectar	18.5
H26	1 969,675	Group I	-	-	Monoflower	Nectar	14.7
H27	110 645	Group II	-	-	Monoflower	Nectar	16.1
H28	77 951	Group II	-	-	Monoflower	Nectar	16.2
H29	78 684	Group II	-	-	Monoflower	Nectar	16
H30	117 107	Group III	-	-	Monoflower	Nectar	16.7
H31	99 753	Group II	-	-	Monoflower	Nectar	16.8
H32	100 410	Group III	-	-	Monoflower	Nectar	16.6
H33	114 611	Group III	-	-	Monoflower	Nectar	16.9
H34	229 257	Group III	-	-	Monoflower	Nectar	16.7
H35	68 408	Group II	-	-	Monoflower	Nectar	16.4
H36	92 090	Group II	-	-	Monoflower	Nectar	16
H37	120 251	Group III	-	-	Monoflower	Nectar	16.6
H38	29 329,65	Group II	-	-	Monoflower	Nectar	16.4
H39	46 396,8	Group II	-	-	Monoflower	Nectar	16.5
H40	159 489	Group III	-	-	Monoflower	Nectar	17.3
H41	48 330	Group II	-	-	Monoflower	Nectar	16.4
H42	37 455,75	Group II	-	-	Monoflower	Nectar	16.2
H43	85 953	Group II	-	-	Monoflower	Nectar	16.4
H44	40 059	Group II	-	-	Monoflower	Nectar	16.5
H45	99 373	Group II	-	-	Monoflower	Nectar	16.5
H46	66 502	Group II	-	-	Monoflower	Nectar	16.9
H47	27 127	Group II	-	-	Monoflower	Nectar	16.6
H48	66 695	Group II	-	-	Monoflower	Nectar	16.7
H49	118 026	Group III	-	-	Monoflower	Nectar	16.5
H50	36 433,38	Group II	-	-	Monoflower	Nectar	16.7
H51	138 298	Group III	-	-	Monoflower	Nectar	16.3
H52	9 666	Group I	-	-	Monoflower	Nectar	16.2
H53	75 947	Group II	-	-	Monoflower	Nectar	16.5

Honey sample	TPN_{10}	Maurizio's classification	HDE_{10}	HDE10/TPN10	Source of honey	Type of honey	Moisture
H54	30 609	Group II	-	-	Monoflower	Nectar	16.3
H55	9 666	Group I	-	-	Monoflower	Nectar	16.5
H56	18 727	Group I	-	-	Monoflower	Nectar	16.4
H57	31 840	Group II	-	-	Monoflower	Nectar	16.6
H58	105 709	Group III	-	-	Monoflower	Nectar	16.5
H59	70 504	Group II	-	-	Monoflower	Nectar	16.5
H60	8 825	Group I	-	-	Monoflower	Nectar	16.5
H61	106 111	Group I	-	-	Monoflower	Nectar	16.5
H62	75 345	Group II	-	-	Monoflower	Nectar	15.8
H63	28 998	Group II	-	-	Monoflower	Nectar	16.5
H64	2 416,5	Group I	-	-	Monoflower	Nectar	16.1
H65	41 886	Group II	-	-	Monoflower	Nectar	16.4

3.2.Physicochemical analysis

The investigated honey samples are proper according to the moisture content. All the samples contained less than 20% moisture content which is safety against fermentation. It changes according to the climatic factors, harvesting season, the maturity degree of honey and environmental factors [16].

3.3.Sensory analysis

According to the sensory analysis colour intensity observed between 1-5. Mostly the colour of honeydew honeys were evaluated as degree 4 (Table 7). Intensity of odour were scored 1 to 3 and most of the samples evaluated as degree 2. Sweetness, intensity of aroma and crystallization rate were also scored. It is observed that crystallization ratios were low in honeydewhoneys as known.

By the assessors, it is mentioned that floral odour and aroma especially *Thymus* spp. odour was sensed in all the samples in different proportions.

TABLE 6. Sensory analysis results of the honey samples (H1-26)

Honey number		H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15	H16	H17	H18	H19	H20	H21	H22	H23	H24	H25	H26
Colour intensity (from 1to5)		2	2	3	3	2	5	5	3	3	4	4	4	3	4	2	2	2	4	1	4	3	5	1	5	3	5
Intensity of odour (from 0 to 3)		2	2	2	3-Feb	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	3-Feb	2	2	2	2	2
	Floral	+	+	+	+	+		+	+						+	+		+			+	+	+	+	+	+	+
	Vegetal																										
	Woody	+	+	+						+	+	+	+		+		+		+	+							
Sweetness (from 1 to 3)		1	1	2	2	2	2	3-Feb	2	1	1	1	1	2	2	2	1	2	1	1	2	3-Feb	2	2	2	2	2
Intensity of aroma (from 0 to 3)		1	1	1	2	1	1	2	1	1	1	1	1	1	3	2	1	1	1	1	2	1	2	1	1	1	2
Crystallisation rate (from 1 to 3)		2	2	2	2	2	2	2	2	1	1	1	1	2	1	1	1	1	1	1	2	2	2	2	2	2	2

TABLE 6. (Continued) Sensory analysis results of the honey samples (27-49)

Honey number		H27	H28	H29	H30	H31	H32	H33	H34	H35	H36	H37	H38	H39	H40	H41	H42	H43	H44	H45	H46	H47	H48	H49
Colour intensity (from 1to5)		2	3	2	2	2	2	2	2	2	2	2	4	2	2	2	2	2	2	2	2	2	2	2
Intensity of odour (from 0 to 3)		2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1	2	2	1	2	2	2
	Floral	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Vegetal												+											
	Woody																							
Sweetness (from 1 to 3)		2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2
Intensity of aroma (from 0 to 3)		2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2
Crystallisation rate (from 1 to 3)		2	2	2	2	2	2	2	2	2	2	2	1	3-Feb	2	2	2	2	2	2	2	2	2	2

TABLE 6. (Continued) Sensory analysis results of the honey samples (27-49)

Honey number		H50	H51	H52	H53	H54	H55	H56	H57	H58	H59	H60	H61	H62	H63	H64	H65
Colour intensity (from 1to5)		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Intensity of odour (from 0 to 3)		2	2	2	1-2	2	1-2	2	1	2	2	2	2	2	2	2	2
	Floral	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Vegetal																
	Woody																
Sweetness (from 1 to 3)		2	2	2	1-2	2	1-2	2	2	1-2	2	2	2	2	2	2	2
Intensity of aroma (from 0 to 3)		2	2	2	1-2	2	2	2	2	1-2	2	2	2	2	1	2	2
Crystallisation rate (from 1 to 3)		2	2	2	2	1-2	2	1-2	2	2	2	2	2	2	2	2	2

4. CONCLUSION

As a part of the study, the honey type variety (multifloral, monofloral, blend, honeydew) was observed special to the Aydın-Karacasu-Dikmen village. As well as, by this research characterization of honey samples from Aegean region of Turkey has been done, which has not detailed with any other research before. This work comprises multifloral, monofloral (*Astragalus*, *Castanea sativa* Miller, *Centaurea, Thymus*, Oleaceae), honeydew honey and blend honey from this region. Also there is no any previous literature data about *Centaurea* honey characterized as monofloral honey by this research.

This results will highligt the rich variety of Aegean honeys and be a step for future researches.

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