International Journal of Food Science and Nutrition
ISSN: 2455-4898
Impact Factor: RJIF 5.14
www.foodsciencejournal.com
Volume 3; Issue 2; March 2018; Page No. 160-165

Effect of processing on proximate composition of honey during storage

Sonia Minhas[1*], YS Dhaliwal[2]
[1] Department of School of Public Health, PGIMER, Chandigarh, Punjab, India
[2] Department of Food Science Nutrition and Technology, CSKHPKV Palampur, Himachal Pradesh, India

Abstract
Background: The research was conducted on two samples of honey viz ripened and unripened honey. Honey were processed at different time viz 12, 24, 36 and 48 hours respectively. The processed honey samples were than packed in glass jars and analyzed fresh and at a storage interval of 3, 6, 9 and 12 months.
Results: Honey samples both ripened and unripened were analysed for moisture content (16.73 and 17.56%), ash content (0.32% and 0.24%), TSS (82.31^{0}Brix and 81.39 ^{0}Brix), pH (5.50 and 4.44), acidity (0.33 % and 0.40%), total sugars (67.41% and 66.06%) and protein (0.33% and 0.29%) respectively.
Conclusion: The values of moisture and acidity were higher in unripened honey whereas, the values of ash, TSS^{0}Brix, pH, total sugars and protein were higher in ripened honey. The results of the study revealed that moisture, ash, pH, total sugars and protein content decreased during storage and TSS and acidity content increased during storage. The quality of honey can be improved by processing honey for 12 to 36 hours.

Keywords: honey, storage, physicochemical parameters, processing honey, processing temperature

Introduction
Honey is produced by bees from plant nectars, plant secretions and excretions of plant-sucking insects and contains macro- and micro-nutrients, sugars, of which fructose and glucose are the main contributors, but also of a wide range of minor constituents, especially phenolic compounds. (Bogdanov *et al*. 2008 and Suarez *et al*. 2010) [2, 11]. Composition of honey mainly depend upon source of flowers, seasonal and environmental factors.
Honey has high nutritional value and properties such as antioxidant, bacteriostatic, medicinal, anti-inflammatory and antimicrobial (Suarez *et al*. 2013) [9]. Honey has high content of sugars such as glucose, fructose and small amounts of other nutrients such as carbohydrates, amino acids, lipids, vitamins and minerals imparts. Proper processing is essential for a product of good sensory qualities. ISI/Agmark specifications for honey, its adulteration and detection of adulteration are well recorded.
People prefer in today's diet mostly processed and heat-treated foods. Although in raw honey many phytonutrients, resins and other substances are present, but processing of honey often removes them. During processing changes more or less occurs in the nutritional composition of foods and foods products. At higher temperatures bioactive compounds are relatively unstable and it leads to loss of natural nutrients. However, heat treatment sometimes causes no change (Šaric *et al*. 2013) [7].

Materials and methods
Materials
Ripened honey was procured from the local market and Bee Keeping Research Station, Nagrota Bhagwan. Standardization of honey was done in Bee Keeping Research Station, Nagrota Bhagwan. Ripened honey was processed at 12, 24, 36 and 48 hrs. The sample of processed honey were packaged in glass jars and analysed fresh and after every 3.0, 6.0, 9.0 and 12.0 months of storage intervals for chemical evaluation. Figure 1 indicates the steps involved in processing of honey.

Processing of honey

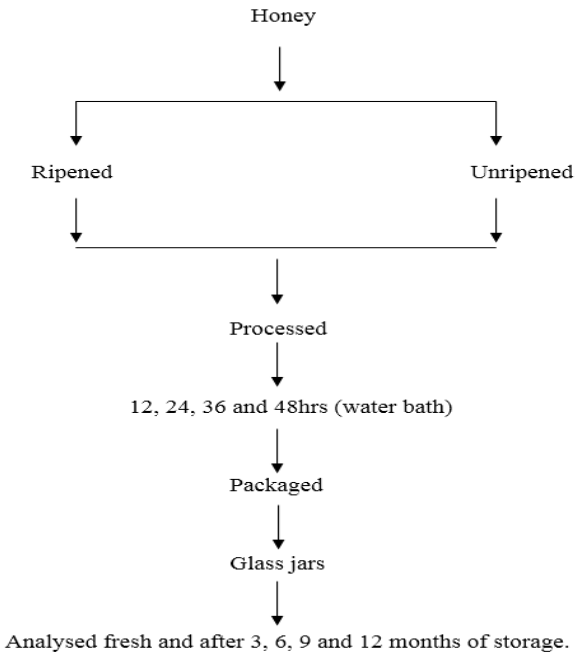

Fig 1: Steps involved for the processing of honey

Results and Discussions

Physico-chemical characteristics of honey

Tables 1 depict the moisture content of honey packaged in glass jars as affected by type, processing temperature, processing time and storage intervals.

Table 1: Mean values of moisture (%) of honey packaged in glass jars as affected by type, processing temperature, processing time and storage interval

Particulars	Storage interval (months)					
Honey	Fresh	3	6	9	12	Mean
Ripened	17.77	17.25	16.60	16.22	15.86	16.73
Unripened	18.43	18.00	17.41	17.12	16.82	17.56
Mean	18.10	17.62	17.00	16.67	16.34	17.14
Processing Temperature (^{0}C)						
60	19.00	18.55	17.95	17.57	16.83	17.98
70	18.14	17.74	16.83	16.34	16.22	17.06
80	17.16	16.56	16.22	16.10	15.96	16.40
Mean	18.10	17.62	17.00	16.67	16.34	17.14
Processing Time (hrs)						
12	18.45	18.03	17.30	16.84	16.58	17.44
24	18.23	17.67	17.15	16.72	16.46	17.25
36	18.04	17.48	16.84	16.58	16.19	17.03
48	17.67	17.30	16.72	16.55	16.11	16.87
Mean	18.10	17.62	17.00	16.67	16.34	17.14
Honey	**Processing Time (hrs)**					
	12		24	36	48	Mean
Ripened	17.06		16.86	16.60	16.41	16.73
Unripened	17.82		17.63	17.45	17.32	17.56
Mean	17.44		17.25	17.03	16.87	17.14

CD (P≤0.05) Between: Types of honey : 0.45, Processing Temperature : 0.55, Processing Time: NS, Storage interval: 0.71

The ripening of ripened and unripened honey packaged in glass jars were 16.73 and 17.56 per cent, respectively.

The processing temperature (60, 70 and 80^{0}C) also had significant effect on the moisture content of honey packaged in glass jars. The honey processed at 80^{0}C of temperature, the moisture content was (16.40%), followed by honey processed at 70^{0}C (17.06%) and 60^{0}C (17.98%). The processing time had non-significant effect on the moisture content of honey packaged in glass jars. The moisture content of honey packaged in glass jars decreased significantly with the increase in storage period. However, the values of moisture content of honey after "6, 9 and 12 months", "3 and 6 months" and fresh and 3 months", of storage varied critically non-significantly. The mean values of fresh honey was 18.10 per cent which decreased to 16.41 per cent and 16.63 per cent after 12 months of storage of honey, respectively.

The author reported higher values of moisture content of honey in range of 22.0 to 29.3 per cent (Rahman *et al*. 2013) [6]. The value of moisture content was higher in unripened honey. This might be due to evaporation of water in ripened honey during inversion process. The moisture content of honey packaged in glass jars decreased significantly with the increase of storage period. The results of moisture content of honey are in agreement with the findings of author who reported moisture content range from 15.00 to 17.33 per cent (Buba *et al.* 2013) [3].

Ash content

Tables 2 indicate the ash content of honey packaged in glass jars as affected by type of honey, processing temperature, processing time and storage intervals. The ripened honey had significantly higher values of ash content packaged in glass jars with mean values of 0.32, per cent, respectively. The processing temperature used for processing of honey had significant effect on the ash content that increased with increase in processing temperature. The mean values of ash content of honey processed at 60^{0}C packaged in glass jars 0.20 per cent which increased to 0.36 per cent in honey processed at 80^{0}C, respectively.

The processing time also had significant effect on the ash content increased slightly with the increase in processing time. The ash content of honey processed for 12 hours and packaged in glass jars was 0.25 per cent which increased to 0.31 per cent after 48 hours of processing time, respectively. However, the mean values of honey processed at "12 and 24 hours", "24 and 36 hours", and "36 and 48 hours" varied critically non-significant in case of honey packaged in

Table 2: Mean values of ash (%) of honey packaged in glass jars as affected by type, processing temperature, processing time and storage interval

Particulars	Storage interval (months)					
Honey	Fresh	3	6	9	12	Mean
Ripened	0.32	0.35	0.35	0.31	0.26	0.32
Unripened	0.26	0.26	0.26	0.22	0.20	0.24
Mean	0.30	0.30	0.30	0.26	0.23	0.28
Processing Temperature (^{0}C)						
60	0.21	0.22	0.22	0.18	0.15	0.20
70	0.29	0.31	0.31	0.26	0.23	0.28
80	0.37	0.38	0.38	0.34	0.31	0.36
Mean	0.30	0.30	0.30	0.26	0.23	0.28
Processing Time (hrs)						
12	0.27	0.27	0.27	0.23	0.19	0.25
24	0.28	0.29	0.29	0.25	0.22	0.27
36	0.30	0.31	0.31	0.27	0.24	0.29
48	0.32	0.34	0.34	0.29	0.27	0.31
Mean	0.30	0.30	0.30	0.26	0.23	0.28
Honey	**Processing Time (hrs)**					
	12		24	36	48	Mean
Ripened	0.28		0.31	0.32	0.35	0.32
Unripened	0.21		0.23	0.25	0.28	0.24
Mean	0.25		0.27	0.29	0.31	0.28

CD (P≤0.05) Between: Type of Honey: 0.02, Processing Temperature : 0.03, Processing Time: 0.03, Storage interval: 0.04

Glass jars. The storage of honey also had significant effect on the ash content. The fresh honey had ash content of 0.30 per cent which decreased to 0.23per cent after 12 months of storage of honey packaged in glass jars, respectively. However, the values of ash content of "fresh and 3 months", "3 and 6 months" and "9 and 12 months" in glass jars varied critically non-significantly.

In the present study the values of ash content ranged from 0.20-0.29 per cent. The ash content of honey ranged from 0.19- 0.27 per cent and the results of the present study are in agreement with the findings of the author (Adeniyi *et al.*

2014) [1]. The results of the present study are also in agreement with the findings of author who reported the values of ash content ranging from 0.14 to 0.61 per cent (Rahman *et al*. 2013) [6]. The ash content of honey decreased with the increase in storage period. The results of the present study of ash content are in agreement with the findings of author who reported the ash content of honey as 0.28-0.60 per cent. (Buba *et al*. 2013) [3].

Total Soluble Solids (TSS)

Table 3 depict the TSS of honey packaged in glass jars as affected by type, processing temperature, processing time and storage intervals. The ripening of honey had significant effect on the TSS of honey packaged in glass jars. The TSS of ripened honey was higher with mean value of 82.31^0B as compared to TSS of unripened honey with mean value of 81.39^0B.

The processing temperature used for processing of honey had significant effect on the TSS of honey packaged in glass jars. The honey processed at 80^0C of temperature, the TSS of honey was 82.90^0B, followed by honey processed at 70^0C (81.86^0B) and 60^0C (80.78^0B).

The processing time had significant effect on the TSS of honey packaged in glass jars and TSS increased slightly with the increase in processing time. The TSS of honey processed for 12 hours was 81.73^0B which increased to 81.99^0B after 48 hours of processing time. The storage of honey had significant effect on the TSS of honey packaged in glass jars. The mean value of TSS of fresh honey was 81.52^0B which increased to 82.11^0B and 81.70^0B of honey packaged in glass jars, respectively. The values of TSS of honey processed for "24 and 36" hours and "36 and 48 hours" were critically non-significant in case of honey packaged in glass jars.

Table 3: Mean values of TSS (^{0}Brix) of honey packaged in glass jars as affected by type, processing temperature, processing time and storage interval

Particulars	Storage interval (months)					
Honey	Fresh	3	6	9	12	Mean
Ripened	81.95	82.18	82.28	82.37	82.76	82.31
Unripened	81.10	81.38	81.50	81.54	81.47	81.39
Mean	81.52	81.78	81.89	81.96	82.11	81.85
Processing Temperature (^{0}C)						
60	80.50	80.69	80.80	80.88	81.03	80.78
70	81.53	81.80	81.90	81.96	82.13	81.86
80	82.53	82.85	82.96	83.03	83.16	82.90
Mean	81.52	81.78	81.89	81.96	82.11	81.85
Processing Time (hrs)						
12	81.51	81.65	81.75	81.81	81.95	81.73
24	81.52	81.70	81.82	81.90	82.03	81.79
36	81.52	81.84	81.94	82.01	82.13	81.89
48	81.53	81.93	82.04	82.11	82.33	81.99
Mean	81.52	81.78	81.89	81.96	82.11	81.85

Honey	Processing Time (hrs)				
	12	24	36	48	Mean
Ripened	82.23	82.27	82.35	82.39	82.31
Unripened	81.24	81.32	81.42	81.59	81.39
Mean	81.73	81.79	81.89	81.99	81.85

CD (P≤0.05) Between
Type of Honey: 0.13, Processing Temperature: 0.16, Processing Time: NS Storage interval : 0.21

The results of the present study revealed that TSS of honey was higher in honey packaged in glass jars with mean values of 81.85 per cent. The values of TSS (81.30-83.95%) of honey as observed in the present study are agreement with those reported by author (Singh *et al*. 2006) [8]. The TSS of honey decreased significantly with the increase in storage duration due to solubilization of insoluble position of honey due to presence of acids during storage period

pH

The data pertaining to pH of honey packaged in glass jars as affected by type of honey, processing temperature, processing time and storage intervals are given in Tables 4 respectively. The ripened honey had significant effect on the pH of honey. Higher values were observed in case of ripened honey (5.50) as compared to unripened honey (4.44) packaged in glass jars, respectively.

Table 4: Mean values of pH of honey packaged in glass jars as affected by type, processing temperature, processing time and storage interval

Particulars	Storage interval (months)					
Honey	Fresh	3	6	9	12	Mean
Ripened	5.90	5.68	5.48	5.28	5.16	5.50
Unripened	4.92	4.66	4.34	4.20	4.08	4.44
Mean	5.41	5.17	4.91	4.74	4.62	4.97
Processing Temperature (^{0}C)						
60	5.33	5.12	4.82	4.60	4.51	4.88
70	5.37	5.16	4.91	4.74	4.61	4.96
80	5.54	5.22	5.00	4.87	4.74	5.07
Mean	5.41	5.17	4.91	4.74	4.62	4.97
Processing Time (hrs)						
12	5.38	5.15	4.88	4.69	4.57	4.93
24	5.41	5.16	4.90	4.72	4.61	4.96
36	5.42	5.18	4.92	4.75	4.65	4.98
48	5.43	5.19	4.95	4.79	4.66	5.00
Mean	5.41	5.17	4.91	4.74	4.62	4.97

Honey	Processing Time (hrs)				
	12	24	36	48	Mean
Ripened	5.46	5.48	5.51	5.53	5.50
Unripened	4.40	4.43	4.46	4.48	4.44
Mean	4.93	4.96	4.98	5.00	4.97

CD (P≤0.05) Between
Type of Honey : 0.38, Processing Temperature : 0.47, Processing Time : 0.54 Storage interval : 0.61

The processing temperature had significant effect on the pH of honey packaged in different containers glass jars. The mean values of pH of honey processed at 60^0C were 4.88 which increased to 5.07when processed at 80^0C packaged in glass jar, respectively.

The processing time also had significant effect on the pH of honey. The pH of honey processed for 12 hours was 4.93 which increased to 5.00 after 48 hours of processing time packaged in glass jar respectively. However, the mean values of honey processed for "12 and 24 hours" and packaged in glass jars varied critically non-significant.

The storage of honey had significantly decreasing effect on the pH of honey packaged in different containers viz. glass jars. The mean value of pH of fresh honey was 5.41 which decreased to 4.62 after 12 months of storage packaged in glass

jars respectively

The pH values of honey used in study ranged between 4.44-5.62. Author has reported pH value range from 3.1 to 4.1 and results of the present study are in agreement with the findings of the author (Rahman *et al.* 2013) [6]. However, author reported slightly higher value of pH (4.43) as compared to pH of honey determined in the present study (Odeyemi *et al.* 2013) [5]. The pH of honey decreased with the increase in storage duration due to some of the solids undergoing reduction and becoming salts and bases thereby, resulting in the slight pH variations.

Acidity

Table 5 indicate the acidity content of honey packaged in glass jars pouches as affected by type of honey, processing temperature, processing time and storage intervals. The ripened honey had significant effect on the acidity content of honey packaged in glass jars. The mean values of acidity of ripened and unripened honey were 0.33 and 0.40 per cent, respectively.

Table 5: Mean values of acidity (% as citric acid) of honey packaged in glass jars as affected by type, processing temperature, processing time and storage interval

Particulars	Storage interval (months)					
Honey	Fresh	3	6	9	12	Mean
Ripened	0.26	0.30	0.34	0.38	0.44	0.33
Unripened	0.32	0.36	0.40	0.43	0.48	0.40
Mean	0.29	0.33	0.37	0.40	0.44	0.36
Processing Temperature (^{0}C)						
60	0.20	0.24	0.29	0.33	0.37	0.29
70	0.29	0.33	0.37	0.41	0.44	0.37
80	0.37	0.41	0.44	0.48	0.52	0.44
Mean	0.29	0.33	0.37	0.40	0.44	0.36
Processing Time (hrs)						
12	0.26	0.30	0.34	0.38	0.41	0.34
24	0.28	0.32	0.36	0.39	0.43	0.36
36	0.30	0.34	0.38	0.41	0.45	0.37
48	0.31	0.36	0.39	0.43	0.47	0.39
Mean	0.29	0.33	0.37	0.40	0.44	0.36

Honey	Processing Time (hrs)				
	12	24	36	48	Mean
Ripened	0.30	0.32	0.34	0.36	0.33
Unripened	0.37	0.39	0.41	0.42	0.40
Mean	0.34	0.36	0.37	0.39	0.36

CD (P≤0.05) Between
Type of Honey: 0.14, Processing Temperature : 0.17, Processing Time: 0.19, Storage interval: 0.22

The processing temperature also had significant effect on the acidity content of honey packaged in glass jars. The higher values of acidity (0.44%) was observed in honey processed at 80^{0}C, followed by the acidity (0.37%) of honey processed at 70^{0}C and acidity (0.29%) of honey processed at 60^{0}C. The processing time had significant effect on the acidity content of honey and the mean values of acidity content of honey processed at 60^{0}C packaged in glass jars was 0.29 per cent which increased to 0.44 per cent of honey processed at 80^{0}C, respectively. However, the mean values of honey processed for "24 and 36 hours" in case of honey packaged in glass jars varied critically non-significantly. The mean values of fresh honey was 0.29 per cent which increased to 0.44 per cent after 12 months of storage of honey packaged in glass jars respectively. The mean values of acidity present in unripened and ripened honey were 0.40 and 0.33 per cent, respectively. The author reported slightly higher values of acidity content range from 23.88-33.42 per cent respectively (Odeyemi *et al.* 2013) [5].

Sugars

Total sugars

The data pertaining to total sugars of honey packaged in glass jars as affected by type of honey, processing temperature, processing time and storage intervals are given in Table 6 respectively. The ripened honey had significant effect on total sugars of honey packaged in glass jars with the mean values of 67.41 per cent, respectively. The processing temperature used for processing of honey had significant effect on total sugars packaged in glass jars with the mean value of 65.26 per cent processed at 60^{0}C which increased to 68.28 per cent of honey processed at 80^{0}C. However, total sugars present in honey processed at "70 and 80^{0}C" varied critically non-significant.

The processing time used for processing of honey had significant effect on total sugars packaged in glass jars. The mean values of total sugar of honey processed for 12 hours and packaged in glass jars was 66.20 per cent which increased slightly to 67.34 per cent of honey processed for 48 hours, respectively. The mean values of non-reducing sugars of honey processed for "12 and 24 hours", "24 and 36" hours and "36 and 48 hours" were varied critically non-significant of honey packaged in glass jars.

Table 6: Mean values of total sugar (%) of honey packaged in glass jars as affected by type, processing temperature, processing time and storage interval

Particulars	Storage interval (months)					
Honey	Fresh	3	6	9	12	Mean
Ripened	68.89	68.60	67.40	66.13	65.50	67.41
Unripened	67.45	67.03	66.25	65.53	64.60	66.06
Mean	68.17	67.81	66.82	65.83	65.05	66.74
Processing Temperature (^{0}C)						
60	66.40	66.33	65.41	64.45	63.69	65.26
70	68.17	67.52	66.80	65.81	65.06	66.67
80	69.92	69.59	68.26	67.23	66.41	68.28
Mean	68.17	67.81	66.82	65.83	65.05	66.74
Processing Time (hrs)						
12	67.59	67.26	66.29	65.31	64.54	66.20
24	67.95	67.45	66.66	65.66	64.88	66.52
36	68.32	67.97	66.99	66.01	65.21	66.90
48	68.80	68.58	67.36	66.35	65.59	67.34
Mean	68.17	67.81	66.82	65.83	65.05	66.74

Honey	Processing Time (hrs)				
	12	24	36	48	Mean
Ripened	66.86	67.20	67.62	67.98	67.41
Unripened	65.54	65.84	66.17	66.70	66.06
Mean	66.20	66.52	66.90	67.34	66.74

CD (P≤0.05) Between:
Type of Honey : 0.37, Processing Temperature : 0.45, Processing Time : 0.52, Storage interval: 0.58

The values of total sugars of honey packaged for "12 and 24 hours", "24 and 36" hours and "36 and 48 hours" varied

critically non-significant in case of honey packaged in glass jars.

The storage intervals also had significantly decreasing effect on the total sugars of honey packaged in glass jars. The mean value of total sugars of fresh honey was 68.17 per cent which decreased to 66.74 per cent after 12 months of storage of honey packaged in glass jars respectively. However, the values of total sugars of "fresh and 3 months" in glass jars was varied critically non-significant.

The results of present study revealed that total sugars of honey was higher in glass jars with mean value of 66.74 per cent. The value of sugars in ripened honey was higher as compared to unripened honey. This increase in value might be due to early harvesting which resulted into incomplete inversion of sugars in unripened honey and thereby reducing the level of different reducing sugars as compared to ripened honey. The author reported similar findings that the values of total sugars in ripened honey were higher as compared to unripened honey (Singh *et al.* 2006) [8]. The results of the present findings are in agreement with the findings of author who reported the sugars varied from 42.5-81.7 per cent (Rahman *et al*. 2013) [6].

Protein

The data pertaining to protein content of honey stored in glass jars as affected by type of honey, processing temperature, processing time and storage intervals are given in Table 7 respectively. The ripened honey had significant effect on the protein content of honey packaged in glass jars. The mean values of protein content of ripened and unripened honey were 0.33 and 0.29 per cent in glass jars.

The processing temperature had non-significant effect on the protein content of honey packaged in glass jars. The honey processed at 80^0C of temperature, the protein content was 0.36 per cent followed by honey processed at 70^0C (0.31%) and 60^0C (0.26%).

The processing time used for processing of honey had significant effect on the protein content and slightly increased with the increase in processing time. The protein content of honey processed for 12 hours and packaged in glass jars was 0.29 percent which increased to 0.33 percent after 48 hours of processing time, respectively. However, the mean values of honey processed at "12 and 24 hours" in glass jars varied critically non-significant.

Table 7: Mean values of protein (%) of honey packaged in glass jars as affected by type, processing temperature, processing time and storage interval

Particulars	**Storage interval (months)**					
Honey	Fresh	3	6	9	12	Mean
Ripened	0.33	0.35	0.35	0.32	0.30	0.33
Unripened	0.31	0.29	0.29	0.30	0.29	0.29
Mean	0.32	0.32	0.32	0.31	0.29	0.31
Processing Temperature (^{0}C)						
60	0.27	0.27	0.27	0.25	0.24	0.26
70	0.32	0.32	0.32	0.30	0.29	0.31
80	0.37	0.37	0.37	0.36	0.35	0.36
Mean	0.32	0.32	0.32	0.31	0.29	0.31
Processing Time (hrs)						
12	0.30	0.30	0.30	0.29	0.27	0.29
24	0.31	0.31	0.31	0.30	0.29	0.30
36	0.33	0.33	0.33	0.31	0.30	0.32
48	0.34	0.34	0.34	0.33	0.31	0.33
Mean	0.32	0.32	0.32	0.31	0.29	0.31

Honey	Processing Time (hrs)				
	12	24	36	48	Mean
Ripened	0.31	0.32	0.34	0.35	0.33
Unripened	0.27	0.28	0.30	0.31	0.29
Mean	0.29	0.30	0.32	0.33	0.31

CD (P≤0.05) Between:

Type of Honey : 0.01, Processing Temperature : 0.02, Processing Time: 0.02, Storage interval : NS

The protein content of honey packaged in glass jars. The mean values of protein of fresh honey was 0.32 per cent which decreased to 0.29, 0.28 and 0.27 per cent after 12 months of storage of honey packaged in glass jars. However, the mean values of "fresh and 3 months", "3 and 6 months", and "6 and 9 months" in glass jars varied critically non-significant.

The mean values of protein content of the present study are in the range 0.28 to 0.39 per cent. The results of present study are in agreement with the values as reported by author, who reported the protein content of 0.36-1.02 per cent (Chua and Adnan 2014). The protein content decreased with increase in storage period. However, author reported higher value of protein content (0.69 and 0.74%) of honey (Adeniyi *et al*. 2014) [1]. The author reported higher value of protein content (0.69 and 0.74 %) of honey (Bogdanov *et al*. 2008) [2].

Conclusion

The values of moisture and acidity were higher in unripened honey whereas, the values of ash, TSS^{0}Brix, pH, total sugars and protein were higher in ripened honey. The results of the study revealed that moisture, ash, pH, total sugars and protein content decreased during storage and TSS and acidity content increased during storage. The quality of honey can be improved by processing honey for 12 to 36 hours.

References

1. Adeniyi KA, Daudu AY, Abubakar A, Ismail AD, Busari MB, Abdulsalami H, Usman KA, *et al*. Comparative Analysis of the Proximate and Nutritional Compositions of Nigerian Bitter and Sweet Honey from Apis mellifera. International Journal of Scientific and Research Public, 2014, 4.
2. Bogdanov S, Jurendic T, Sieber R, Gallmann P. Honey for nutrition and health: A review. American Journal College of Nutrition. 2008; 27:677-689.
3. Buba F, Gidado A, Shugaba A. Analysis of Biochemical composition of honey samples from North-East Nigeria. Biochemistry Analytical biochemistry. 2013; 2:3:2-7.
4. Chua LS, Adnan NA. Biochemical and nutritional components of selected honey samples. Acta Scientarium Polonorium Technologia Alimentaria. 2014; 13(2):169-179.
5. Odeyemi AT, Adefemi SO, Adewole Alaba Adebayo AA. Antimicrobial and Proximate Properties of Some Processed Honey in Ado-Ekiti. International Journal of Aquatic Science. 2013; 4(1):36-43.
6. Rahman K, Hussain A, Ullah S, Imdad Ullah Muhammad Zai. Phytochemical Analysis and Chemical Composition of Different Branded and Unbranded Honey Samples. International Journal of Microbiological Research. 2013; 4(2):132-137.
7. Šaric G, Markovic K, Vukicevic D, Lez E, Hruskar M, Nada V, *et al*. Changes of Antioxidant Activity in Honey after Heat Treatment. Czech Journal of Food Science. 2013; 31(6):601-606.
8. Singh B, Sarkar BC, Sharma HK, Singh C. Comparative studies on ripened and unripened honey of unifloral Brassica juncea. Journal Food Science Technology. 2006; 43(5):535-537.
9. Suarez JMA, Giampieri Battino F. Honey as a source of dietary antioxidants: Structures, bioavailability and evidence of protective effects against human chronic diseases. Current Medical Chemistry. 2013; 20:621-638.
10. Suarez JMA, Giampieri F, Paramás AMG, Damiani E, Astolfi P, Sanchez GM, Bompadre S, Quiles JL, Buelga CS, Battino M, *et al*. Phenolics from monofloral honeys protect human erythrocyte membranes against oxidative damage. Food and Chemistry Toxicology. 2012; 50:1508-1516.
11. Suarez JMA, Tulipan S, Romandini S, Bertoli E. Battino Contribution of honey in nutrition and human health: A review. Mediterranean Journal of Nutrition and Metabolism. 2010; 3:15-23.