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Comparative study on ripened and unripened honey during storage

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Abstract
Honey is a sweet, viscous liquid and valued not only as a food but also for some of its therapeutic attributes. It improves the resistance of the body and also good for diabetics and to normalize kidney function. The two varieties of honey i.e. ripened and unripened and analysed fresh and after 3, 6, 9 and 12 months of storage intervals. Higher values of moisture, acidity and fructose were recorded in case of unripened honey were 17.56, 0.40 and 35.19 per cent, respectively. However, the values of TSS, ash, pH, sugars, glucose, protein, diastatic activity and energy were 82.31^{0}B, 0.32, 5.50, 67.41, 33.05, 0.33 per cent and 326.50 Kcal/100g were higher in ripened honey. Ripened and unripened honey were evaluated for sensory evaluation, respectively. It was concluded from the study that the honey can be used as a substitute for sugar in the preparation of products and it also improved the overall acceptability.

Keywords: Honey, Ripened honey, unripened honey, Physico-chemical parameter

Introduction
Honey means the food derived entirely from the work of bees operating upon the nectar of flowers and other sweet exudation of plants. In India, the consumption of honey is mainly restricted to medicinal purposes. Honey is well known for healing of wounds and its effect on nervous system. Honey facilitates better physical performance and resistance to fatigue. Honey is used for treating various digestive and assimilation problems. Honey also helps in calcium fixation in bones, cures anaemia, anorexia, insomnia and reduces fever. Honey has a number of by-products viz royal jelly, bee venom and waxes which imparts a peculiar flavor, can be properly removed before processing. Honey crystallizes during storage if not properly processed or pasteurized. Crystallized honey is considered to be adulterated with sugar. The proper processing of honey can overcome the problem of crystallization.

Honey is valued not only as a food but also for some of its therapeutic attributes. It improves the resistance of the body by improving the biological processes of organs and systems. It facilitates proteins and fat digestion thus constitutes an excellent anti-dyspeptogenic factor (Shamala and Jyothi 1999) [14]. Honey has tonic effect. Its medicinal property neutralizes fatigue, compensatory hypotonia, as well as the adverse effects of the other substances added when used in the preparation of beverages (Shamala and Jyothi 1999) [14].

There are about 2, 76,000 bee keepers in India. The national production of honey is about 27,000 tonnes per annum. The production has come down by 75 per cent over the last few years in several places because of the damage caused by Thia Sac Brood Virus disease. The total world production of honey is around 11, 70,000 tonnes. China which is the largest producer, exports 70,000 tonnes of honey compared to 1000 tonnes by India. The consumption of honey as a food is very low in India due to food habits, high cost and utilization of major quantity for medicinal purposes (Shamala and Jyothi 1999) [14].

To produce a tablespoonful of honey, a single bee has to visit about 2000 flowers, while a pound of honey in the hive is due to minimum of 38,000 bee trips to and from the flowers. In India, the major quantity of honey is obtained during spring (January to April) in the plains, and in autumn (October-November) on the hills. The bees collect nectar of low sugar content (exceeds 40 per cent) and concentrate it to honey of high sugar content (80 per cent) which is stored hygienically for months together without spoilage.

There are normally two types of honey (ripened and unripened) are available to the market. Unripened honey is the unsealed honey in bee hives and becomes ripened only after it is sealed with air proof wax caps. Honey is highly concentrated water solution of two sugars, fructose and glucose, with small amounts of at least 22 other more complex sugars. Many other substances also occur in honey, but the sugars are by far the major components.

Honey is also mainly composed of simple sugars, fructose and glucose. Honey provides immediately available calories, which derives its energy value for healthy and sick people. Honey consumption benefits digestive apparatus, respiratory system, skin and wound healing and eye disorders. Honey is also good for diabetics and to normalize kidney function. Processing of honey is the practical means for preventing granulation and fermentation, but can easily deteriorate quality. Heat processing of honey is essential to extend its shelf life, prevents granulation and fermentation. Uncontrolled heat processing of honey results into hydroxymethylfurfural formation which darkens colour of honey. Although raw is the best honey, but processing is needed to meet the market requirements.

Honey with a glucose/water ratio < 1.7 tends to remain liquid for a long time, while ratio > 2.1 usually crystallizes within weeks. During processing, several steps are taken to prolong the liquid state of honey. Pasteurization delays the process of crystallization by dissolving the crystals. It also kills yeast cells

and thereby eliminates the possibility of fermentation. To delay crystallization, some researchers recommend heating the honey to 77 ^{0}C for 5 minutes, cooling rapidly to room temperature, bottling and stored honey at 0 ^{0}C (Assil *et al* 1991) [2].

With an increasing amount of honey production, an understanding of the changes in honey during storage is essential to maintain its quality. In India, however, very little work has been carried out on keeping quality of honey and no comparative studies on ripened and unripened honey have so far reported. Therefore, in the present study effect of different treatments and storage conditions on the quality of ripened and unripened honey during storage were determined and compared.

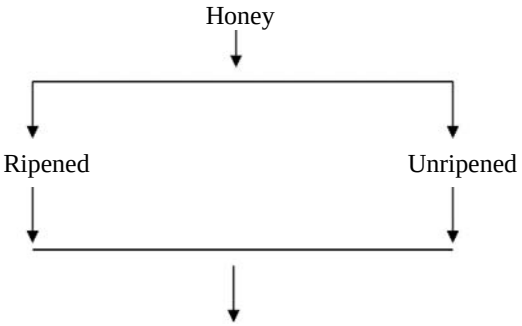
2. Materials and methods

Materials

The honey i.e. Ripened as well as Unripened required for the present study were procured from the local market and Bee Keeping Research Station, Nagrota Bhagwan. The other ingredients required for the research study and preparation of food products were purchased from the local market.

Standardization of honey

Standardization of honey was done in Bee Keeping Research Station, Nagrota Bhagwan. Two types of Honey i.e. ripened and unripened the sample of honey analysed fresh and after every 3.0, 6.0, 9.0 and 12.0 months of storage intervals for chemical and sensory evaluation.



Analysed fresh and after 3, 6, 9 and 12 months of storage

3. Results and discussion

Physico-chemical characteristics of honey

Moisture content

The data pertaining to moisture content of honey packaged in glass jars as affected by type of honey and storage intervals are given in Table 1 respectively. The ripening of honey had significant effect on the moisture content of honey packaged in glass jars. The mean values of ash content of ripened and unripened honey packaged in glass jars were 0.32 and 0.24 per cent, respectively.

The moisture content of honey packaged in glass jars decreased significantly with the increase of 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

Table 1: Physico-chemical analysis of honey packaged in glass jars as affected by type and storage interval

Particulars		Storage interval (months)						CD (*P*≤0.05)
Honey		Fresh	3	6	9	12	Mean	
Ripened	Moisture (%)	17.77	17.25	16.60	16.22	15.86	16.73	Type of Honey: 0.45 Storage interval: 0.71
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	
Ripened	Ash (%)	0.32	0.35	0.35	0.31	0.26	0.32	Type of Honey: 0.02 Storage interval: 0.04
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	
Ripened	TSS^0 Brix	81.95	82.18	82.28	82.37	82.76	82.31	Type of Honey: 0.13 Storage interval: 0.21
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	
Ripened	pH	5.90	5.68	5.48	5.28	5.16	5.50	Type of Honey: 0.38 Storage interval: 0.61
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	
Ripened	Acidity (%)	0.26	0.30	0.34	0.38	0.44	0.33	Type of Honey: 0.14 Storage interval: 0.22
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	
Ripened	Reducing Sugars (%)	59.36	59.81	60.51	61.11	61.62	60.48	Type of Honey: 0.35 Storage interval: 0.55
Unripened		58.66	59.30	59.74	60.30	60.95	59.79	
Mean		59.01	59.55	60.12	60.70	61.30	60.14	
Ripened	Non-reducing Sugars (%)	9.74	8.86	7.10	5.16	3.89	6.95	Type of Honey: 0.27 Storage interval: 0.43
Unripened		8.67	7.70	6.32	5.09	3.58	6.27	
Mean		9.20	8.28	6.71	5.12	3.73	6.61	
Ripened	Total Sugars (%)	68.89	68.60	67.40	66.13	65.50	67.41	Type of Honey: 0.37 Storage interval: 0.58
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	
Ripened	Fructose (%)	35.74	35.55	35.20	33.95	33.86	34.86	Type of Honey: NS Storage interval: 0.61
Unripened		35.62	35.39	35.16	34.93	34.85	35.19	
Mean		35.68	35.47	35.18	34.44	34.35	35.02	
Ripened	Glucose (%)	32.84	32.96	33.06	33.20	33.24	33.05	Type of Honey: NS Storage interval: NS
Unripened		32.40	32.54	32.65	32.67	32.77	32.61	
Mean		32.62	32.75	32.85	32.93	33.00	32.83	
Ripened	Protein (%)	0.33	0.35	0.35	0.32	0.30	0.33	Type of Honey: 0.01 Storage interval: NS
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	
Ripened	Diastatic Activity	21.05	18.94	17.91	17.20	16.92	18.40	Type of Honey: 0.30 Storage interval: 0.47
Unripened		20.19	18.70	17.63	17.04	16.79	18.07	
Mean		20.62	18.82	17.77	17.12	16.85	18.24	
Ripened	Energy (Kcal/100g)	326.17	326.17	326.16	324.96	325.06	326.50	Type of Honey: 0.54 Storage interval: NS
Unripened		312.00	312.00	314.01	314.86	313.76	313.31	
Mean		320.08	320.08	320.08	319.91	319.37	319.90	

Varied critically and were found to be non-significant. The mean values of fresh honey was 18.10 per cent which decreased to 16.43 per cent after 12 months of storage of honey.

The results of the present study of moisture content are in agreement with the findings of Tarboush *et al.* (1993) [16] who reported that the moisture content in range of 15.5-18.2 per cent. The value of moisture content was higher in unripened honey. This might be due to evaporation of water in ripened honey during inversion process. Singh *et al.* (2006) [15] also reported that the moisture content in unripened honey could be attributed 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 the present study in relation to moisture content of honey are in agreement with the findings of Thrasyvoulou (1986) [17] who reported decrease in moisture content from 18.1 to 16.3 per cent with storage.

Ash content

The mean values of ash content of ripened and unripened honey packaged in glass jars were 0.32 and 0.24 per cent, respectively. The storage of honey had significant effect on the ash content. The fresh honey had ash content of 0.30 per cent which decreased to 0.28 per cent after 12 months of storage 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 were varied critically and were found to be non-significant.

Minh *et al.* (1971) reported that the ash content of honey ranged from 0.061- 0.316 per cent and the results of the present study are in agreement with the findings. However, Abdulkar (2003) [1] reported slightly higher values of honey for ash content 0.5 per cent. The results of the present study are also in agreement with the findings of Gulati and Kumari (2005) [10] who reported the values of ash content ranging from 0.05 to 0.12 per cent. The ash content of honey decreased with the increase in storage period irrespective of packaging materials. The results of the present study of ash content are in agreement with the findings of Shamala and Jyothi (1999) [14] who reported the ash content as 0.17 per cent.

Total Soluble Solids (TSS)

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 storage of honey had significant effect on the TSS of honey packaged in glass jars. The mean values of TSS of fresh honey was 81.52^0B which increased to 82.11^0B of honey packaged in glass jars, respectively.

The values of TSS of honey determined in the present study are in the range (81.30-83.95%) as reported by Kaushik (1988) [9], Kumari (1998) [10] and Singh and Sharma (2006) [15]. The results of TSS obtained in the present study are also in conformity with the findings of Yousif *et al.* (1990) [20] and Saini and Grewal (1995) [13] and the values are in range 80.00 to 82.90^0B. The TSS of honey decreased significantly with the increase in storage duration. This might be due to solubilization of insoluble constituents of honey due to presence of acids during storage period.

pH

The ripening of 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.

The storage of honey had significantly decreasing effect on the pH of honey packaged in glass jars. The mean value of pH of fresh honey was 5.41 which decreased to 4.67 after 12 months of storage packaged in glass jars, respectively.

Kaushik (1998) [9] has reported pH value of 4.10 in fresh honey and the results of the present study are in agreement with the findings. However, Shamala and Jyothi (1999) [14] reported slightly less value of pH (3.91) as compared to pH of honey determined in the present study. The pH of honey decreased with the increase in storage duration. This might be due to some of the solids undergoing reduction and becoming salts and bases thereby, resulting in the slight pH variations. These changes were more pronounced in honey packaged in polythene pouches than in plastic jars as well as in glass jars. Wotton *et al.* (1976) [19] and Thrasyvoulou (1986) [17] have also observed a reduction in pH of honey from 3.32 to 3.00 during storage.

Acidity

The ripening of 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.

The storage of honey had significantly increasing effect on the acidity content of honey packaged in glass jars. 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 value of acidity present in unripened and ripened honey were 0.40 and 0.33 per cent, respectively. The results of the present findings are in agreement with the findings of Kaushik *et al.* (1993) [8] who reported that the honey contained 0.25 per cent acidity. The results of the present study of acidity content are also in agreement with the findings of Kumari (1998) [10] who reported acidity content in the range of 0.16 to 0.12 per cent, respectively.

Sugars

Reducing sugars

The ripening of honey had significant effect on the reducing sugars of honey packaged in glass jars. Higher values were observed in case of ripened honey 60.48 per cent as compared to unripened honey 59.79 per cent packaged in glass jars,

respectively.
The storage of honey had significant effect on the reducing sugars of honey packaged in glass jars. The value of reducing sugars of fresh honey was 59.01 per cent which increased to 61.30 per cent after 12 months of storage of honey packaged in glass jars, respectively. However, the values of sugars from "fresh and 3 months" varied critically non-significant in honey packaged in glass jars.

Non- reducing sugars
The ripening of honey had significantly higher values of non-reducing sugars packaged in glass jars with mean values of 6.95 per cent, respectively.
The storage of honey had significant effect on the non-reducing sugars of honey. The mean value of non-reducing sugars of fresh honey was 9.20 per cent which decreased to 3.73 per cent after 12 months of storage packaged in glass jars, respectively.

Total sugars
The data pertaining to total sugars of honey packaged in glass jars as affected by type of honey and storage intervals are given in Table 1, respectively. The ripening of honey had significant effect on total sugars of honey packaged in glass jars with the mean values of 67.41 per cent, respectively.
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 were varied critically non-significant.
Kumari (1998) [10] reported slightly lower values of sugars 57.99 per cent as compared results obtained in present study. 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. Singh *et al.* (2006) [15] reported similar findings that the values of total sugars in ripened honey were higher as compared to unripened honey.
The results of the present findings are in agreement with the findings of Singh *et al.* (2006) [15] who reported the reducing sugars varied from 60.6 to 60.9 per cent and total sugars varied from 68.7 to 69.5 per cent. The sugars significantly increased with increase in storage period. Similar findings were also reported by Kaushik (1988) [9] who reported sugars 80.70 per cent which slightly increased to 80.95 per cent after 6 months of storage.

Fructose
The data pertaining to fructose content of honey packaged in glass jars as affected by type of honey and storage intervals. The ripening of honey had non-significant effect on the fructose content of honey packaged in glass jars. The mean values of fructose content of ripened and unripened honey packaged in glass jars were 34.86 and 35.19 per cent, respectively.
The fructose content of honey packaged in glass jars decreased significantly with the increase of storage period. However, the values of fructose content of honey "fresh and 3 months", "3 and 6 months", "6 and 9 months" and "9 and 12 months" were varied critically non-significant packaged in glass jars. The mean values of fructose content of honey "9 and 12 months" were varied critically non-significant.
The value of fructose content of unripened honey was 35.19 per cent as compared to ripened honey, the value of fructose content was 34.86 per cent. The values of fructose content of honey are in agreement with the present findings as reported by Kaushik (1988) [9] who reported fructose content 35.90 per cent. However, Singh (1994) who reported that fructose content ranged from (38.14 to 42.65%), slightly higher values of fructose content. Similarly, Shamala and Jyothi (1999) [14] reported slightly higher values of fructose content (38.19%). However, Ghoshdastidar and Chakrabarti (1992) [4] reported 1.0 to 1.2 per cent lower values as compared to present findings. The storage also affects the fructose content and decrease in fructose content was observed with the increase in storage period. However, Wotton *et al.* (1976) [19] and Thrasyvoulou (1986) [17] reported slightly increase in fructose content was 34.72 to 35.12 after 6 months of storage whereas, Ghazali and Sin (1986) [3] reported decrease in fructose content was 32.50 to 32.00 per cent after 6 months of storage.

Glucose
The ripening of honey had non-significant effect on glucose content of honey. The storage of honey had significant effect on the glucose content of honey packaged in plastic jars and polypack pouches. The mean values of glucose content of fresh honey was 32.62 which increased to 32.83 per cent after 12 months of storage, of honey packaged in glass jars. The mean values of honey packaged in glass jars had non-significant effect on the glucose content of honey.
The results of the present study of glucose content are in agreement with the findings of Jonathan and White (1993) and Gulati and Kumari (2005) [6] who reported glucose content varied from 22.4 to 32.2 per cent. The values of ripened honey were higher as compared to unripened honey. The increase in values might be due to early harvesting which resulted into incomplete inversion of sugar in unripened honey and thereby reducing the level of different reducing sugars as compared to ripened honey. However, Singh *et al.* (2006) [15] reported slightly lower values of glucose content of honey varied from 30.1 to 31.0 per cent. The glucose content increased with increase in storage period. However, Wotton *et al.* (1976) [19] reported slightly decrease in glucose content from 31.00 to 30.55 per cent during storage. Ghazali and Sin (1986) [3] and Thrasyvoulou (1986) [17] also reported slightly decrease in glucose content from 32.00 to 31.00 after 6 months of storage.

Protein
The data pertaining to protein content of honey stored in glass jars as affected by type of honey and storage intervals are given in Table 1, respectively. The ripening of 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 protein content of honey packaged in glass jars decreased significantly with the increase of storage period. The mean values of protein of fresh honey was 0.32 per cent which decreased to 0.29 per cent after 12 months of storage of honey packaged in glass jars, respectively. However, the mean values of "fresh and 3 months", "3 and 6 months", and "6 and 9 months" in glass jars were varied critically non-significant.

The results of present study are in agreement with the findings as reported by Gopalan *et al.* (1996) [5] who reported the protein content of 0.3 per cent. The protein content decrease with increase in storage period. However, Sahinler and Gul (2004) [12] reported higher value of protein content (0.76%) present in honey. Kumari (1998) [10] reported 0.36 per cent protein in honey which supports the present findings.

Diastatic activity

The ripening of honey had significant effect on the diastatic activity of honey packaged in glass jars. The mean values of diastatic activity present in ripened and unripened honey were 18.40 and 18.07 DN, respectively.

The storage of honey had significant effect on the diastatic activity and the mean value of fresh honey was 20.62 which decreased to 16.85after 12 months of storage of honey, respectively. However, the mean values of storage "9 and 12 months" of honey packaged in glass jars varied critically non-significant.

In the present study the diastatic activity of honey ranged 18.07-18.40 DN. The value of diastatic activity determined in the present study are in the range (2.6-35.6 diastase number) as reported by Hindobro *et al.* (1995) and Vit and Pulcini (1996) [18]. However, Sahinler and Gul (2004) [12] also reported diastatic activity of honey ranged between1.5-13.7 DN. The storage of honey had significantly decreasing effect on the diastatic activity of honey. Kaushik (1988) [9] reported 21.56 per cent diastatic activity which decreased to 18.56 DN with storage, hence it supports present findings.

Energy

The data pertaining to the energy content of honey as affected by type of honey, processing temperature, processing time and storage intervals packaged in glass jars, plastic jars and polypack pouches are given in Table 1, respectively.

The ripening of honey had significant effect on the energy content and higher values of energy were determined in honey packaged in plastic jars and polypack pouches with mean values of 326.68 and 326.12 Kcal/100g, respectively. However, the mean values of types of honey had non-significant effect in case of honey packaged in glass jars. The processing temperature used for processing of honey had significant effect on the energy content and increased with increase in processing temperature irrespective of packaging materials used.

The mean values of energy content of honey processed at 60 ^{0}C packaged in glass jars, plastic jars and polypack pouches were 321.05, 312.38 and 312.33 Kcal/100g which increased to 327.60, 327.59 and 327.52 Kcal/100g of honey processed at 80 ^{0}C, respectively. The processing time also had significant effect on the energy content and slightly increased with the increase in processing time. The energy content of honey processed for 12 hours and packaged in glass jars, plastic jars and polypack pouches were 312.05, 312.38 and 312.33 Kcal/100g which increased to 327.60, 327.59 and 327.52 Kcal/100g after 48 hours of processing time, respectively. The storage of honey irrespective of packaging materials had non-significant effect on the energy content.

The energy content were higher in glass jars with mean values of 320.03 Kcal/100g, followed by plastic jars (319.97 Kcal/100g) and polypack pouches (319.90 Kcal/100g). Gopalan *et al.* (1996) [5] reported the energy content 319 Kcal/100g, hence supports present findings.

Organoleptic evaluation of honey

Colour

The data pertaining to colour of honey packaged in glass jars as affected by type of honey and storage intervals are given in Table 2, respectively. The ripening of honey had significant effect on the colour of honey packaged in glass jars. The mean values of colour of ripened and unripened honey packaged in glass jars were 7.66 and 7.62 (on the basis of 9.0), respectively.

The storage of honey also had significant effect on the colour. The mean values of fresh honey was 7.68 which decreased to 7.62 after 12 months of storage of honey, packaged in glass jars, respectively**.**

Table 2: Mean values of organoleptic evaluation (on the basis of 9.0) of honey packaged in glass jars as affected by type and storage interval

Particulars		Storage interval (months)						CD ($P \leq 0.05$) Between
Honey		Fresh	3	6	9	12	Mean	
Ripened	Colour	7.70	7.67	7.66	7.65	7.64	7.66	Type of Honey: 0.43 Storage interval:0.69
Unripened		7.66	7.63	7.62	7.61	7.60	7.62	
Mean		7.68	7.65	7.64	7.63	7.62	7.64	
Ripened	Taste	7.83	7.79	7.78	7.77	7.75	7.78	Type of Honey: 0.50 Storage interval: 0.79
Unripened		7.78	7.75	7.74	7.73	7.71	7.74	
Mean		7.80	7.77	7.76	7.75	7.74	7.76	
Ripened	Consistency	8.01	7.99	7.98	7.97	7.96	7.98	Type of Honey: NS Storage interval: 0.74
Unripened		7.99	7.98	7.96	7.95	7.94	7.96	
Mean		8.00	7.98	7.97	7.96	7.95	7.97	

Taste

Table 2 indicate the taste of honey packaged in glass jars as affected by type of honey and storage intervals. The ripening of honey had significantly higher values of taste packaged in glass jars with mean value of 7.78 (on the basis of 9.0), respectively.

The storage of honey had significant effect on the taste of honey. The mean value of taste of fresh honey packaged in glass jars was 7.80 which decreased to 7.74, (on the basis of 9.0) after 12 months of storage, respectively.

Consistency

The data pertaining to consistency of honey packaged in glass jars as affected by type of honey and storage intervals are given in Table 2, respectively. The ripening of honey had non-significant effect on the consistency of honey packaged in glass jars. The consistency of the honey also significantly decreased with increase in storage time. The mean values of fresh honey was 8.00 which decreased to 7.95 (on the basis of 9.0) after 12 months of storage of honey packaged in glass jars, respectively.

From the results of the study it has been observed that colour of honey darkens as processing temperature increases it also affect the taste and consistency of honey. Ghazali and Sin (1986) [3] studied effects of storage of honey at room temperature 28±2 ^{0}C and at 50±2 ^{0}C, and reported that darkening of honey more quickly at 50 ^{0}C and affected colour adversely and results are agreements with present findings. Kaushik (1988) [9] reported that the colour of honey was significantly affected by the temperature and at highest temperature maximum deterioration in colour was found and the results are in agreement with the present findings. Gupta *et al.* (1992) also found that storage of honey at 40 ^{0}C resulted in deterioration of colour which is similar to present (findings)

4. Conclusion

Therefore, it can be concluded from the study that the Ripened honey was highly acceptable as compared to unripened honey. Storage of honey showed significantly decreasing effect on the ash, pH, fructose and protein content of honey. However, honey showed increasing effect on the TSS, acidity and glucose content of honey. The ripened honey had significant effect on the protein content of honey and mean values of protein content of ripened and unripened honey were 0.33 and 0.29 per cent. The ripened honey had significant effect on the minerals content of honey. The mean values of sodium, potassium, calcium, magnesium, iron and zinc present in "ripened and unripened honey" were "1.90 and 2.10", "290.00 and 310.00", "7.00 and 9.00", "21.00 and 16.00", "1.00 and 2.00" and "4.00 and 5.00 mg/100g", respectively.

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