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Storage Quality of Some Sudanese Mango pulp Concentrates

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Abstract: This study was carried out to evaluate the effect of storage on the quality of concentrates of mango cultivars (called Dibsha, Galb Altour, Abu-Samaka, Kitchener and Shendi1). Mangoes pulp was concentrated at atmospheric pressure in open steam jacketed kettle. Preserved with potassium metabisulphate, stored at ambient temperature (30±5º C) and determine the appropriate shelf-life for these products. The concentrates appearance good physico-chemical properties: TSS%, pH, titratable acidity, reducing and total sugars. Moreover, best quality attributes to the organoleptic tests: colour, flavor, taste and overall quality; during 12 months storage.

Key words: Mango, concentrate, preservative, organoleptic, shelf-life

Introduction

The mango (*Mangifera indica* L. Family *Anacardiaceae*) is known to have been cultivated by man for over 4000 years of originated apparently in the Indo-Burma region. **FAO (2007**) recorded that more than 26.5 million metric tons of mangos were produced in worldwide in about 90 countries. Mango plays an important role in balancing the diet of human being by providing about 64 – 86 calories energy (**Rathore *et al*., 2007**) In the Sudan, mango is considered as one of the most important fruit crop grown in different states (**Abdel-Rahman, 2009**). She also recorded the mangoes are exported horticultural produce, and it has perfect flavour, attractive colour and excellent taste; in addition it has high nutritive value. The major production of mango is consumed fresh, **Thind *et al*. (2002**) mentioned that mangoes are very poor keeping quality and cannot with stand any adverse climatic condition during storage because it has higher moisture content (85 %). The shelf-life of mango varies among its varieties depending on storage conditions. It ranges from 4 to 8 days at ambient temperature and 2 to 3 weeks in cold storage at 13 °C (**Carrillo *et al*., 2000**). However, large quantities are wasted in developed countries due to post harvest management and lack facilities. To benefit this loss in mango throughout production of the season, ripe mangoes are

used for making stable products (**Srinivasan *et al.*, 2000**), such as juices, jams, pickles, and canned slices, dehydrated and concentrated pulp.

The concentration of mango both as means preserving the fruit and to reducing transportation costs has been considered. The process of mango as concentrate previously described is highly time consuming and costly. Therefore the self stabilization of the fruit in the container is desirable to get a continuous process. Hence the aim of this investigation to make concentrates from some Sudanese mango varieties, establishment of shelf-life of stored concentrates; at 30±5º C; and to find Sudanese specification for these mangos concentrates.

Materials and Methods

Mango fruit cultivars (Dibsha, Galb Altour, Abu-Samaka, Kitchener and Shendi1) were obtained from Shendi town, Sudan. Which were sorted, washed, peeled, sliced and pulped using fruits pulper (Model: REEVES. Type: MDX-207823-HR). Then the mango pulps were concentrated according to **Roy *et al*. (1997),** and stored at ambient temperature (30±5º C) for 12 months. Mangoes pulp was concentrated at atmospheric pressure in open steam jacketed kettle (model: OSK 1602). It's capacity about 60 liters, heated surface area was 0.1964 m^2 and it's evaporation rate was 0.143 kg\min. The pan was heated by steam (steam pressure was 1 kg\cm^2). About 1730 ppm potassium metabisulphate (100 ppm SO_2) were added to preserve the pulp.

The concentrates were filled into coated cans containers, closed, cooled under running water and stored at ambient temperature (30±5ºC). Representative sample from each variety were subjected to microbial, physico-chemical evaluation as well as organoleptic test, at 3 months intervals.

Microbial evaluation: The samples were subjected to microbial evaluations according to **Harrigan (1998**). This included the presence of viable bacteria, flat sour organisms, coliform aerobic and anaerobic, spore forming, yeast and moulds.

***Physico-chemical analyses*:** Total soluble solids (TSS), pH-value, total titratable acidity (as citric acid) using methods recorded by **Ranganna** (**2000**). While the reducing and total sugars were determined using the methods described by **AOAC (2000**).

Organoleptic test: The sensory evaluation was carried out by the ranking method described by **Ali and El-Faki (2006**). Fifteen panelists (semi trained from the Food Research Centre staff) were presented coded concentrates and asked to evaluate colour, flavour, taste and overall quality.

Statistical analyses*:* Replicates of each sample were analyzed using Statistical Analysis System (SAS). The randomized complete design (RCD) was adopted for this study. The analysis of variance and least significant difference (/LSD at 5 %) were used to separate the means according to **Mead and Gurnow (1983**).

Results and Discussion

Physical properties:

The physical properties of the five cultivars of mango were shown in table 1. The colours of mangoes peel are greenish yellow to yellowish to yellowish orange. The weight of the mangoes was within the range of 310.50 - 661.75 g, while the percentage of peels within 19.37 – 27.34 %, and percentage of the stone of fruits within 7.84 – 18.05 %. **Abdel-Rahman (2002**) reported similar findings for some mango cultivars. The yield of pulp was range from 37.32 to 60.44 %. Dibsha cultivar had the highest percent of pulp. All these results were agrees with results obtained by **Abdel-Rahman *et al*. (2007; 2009**) for some Sudanese mango fruits.

Microbial evaluation:

The microbial evaluation illustrated that, the concentrates of Dibsha mango are slightly contaminated with spore forming bacteria (3.0×10^2 cfu/g) when the samples analyzed for zero time readings (Table 2). This could be attributed to the raw material being of high microbial load or due to its high moisture content, but these low numbers were eliminated and vanished out during storage, because another effect of pH which is inalterable for microbial growth. This could be observed cleanly when the sample analyzed after 3, 6, 9 and 12 months, when all tests are negative and samples were free from contamination. **Akhtar *et al*. (2009**) reported that potassium metabisulphite have an inhibitory effect to all bacteria and other microorganisms. **Oyarzabal *et al*. (2003**) observed the effects of potassium metabisulphite and sodium benzoate on the growth of microorganisms in banana puree stored at room temperature.

With regard to concentrates from Shendi1, Abu-Samaka, Kitchener and Galb-Altour, all these samples are free from any bacterial or fungal contamination. These comply with the standards being conducted by the Sudanese Standards and Metrology Organization (**SSMO**, **2001**) for microbial levels for foods. The concentration of chemical preservatives as potassium sorbate 400 ppm, sodium benzoate 500 ppm and potassium metabisulphite 1000 ppm showed the batter effect on the control of microorganisms even after three months of storage period (**Amin *et al*., 2008**).

Chemical composition:

TSS%: It was observed that the TSS content of concentrates samples were significantly ($P\leq0.05$) increased with the passage of time (Fig. 1). The results showed that, maximum increased were obtained in Galb-Altour concentrate (7.84%), while minimum increased was observed in Dibsha concentrate (0.45%). **Khan *et al.* (2012**); **Ogiehor and Ikenebomehclearly (2004**) found the same result for stored mango juice and pulp preserved

with potassium metabisulphate. This incline in TSS% is due to the development of pectin (water soluble) from insoluble protopectin (**Younis *et al*., 2011**).

pH-value: pH of concentrates has significantly (P≤0.05) decreased at the end of storage period (Fig. 2). The maximum decreased was reported in Shendi1 concentrate (16.15%), whereas the minimum decreased was observed in Dibsha concentrate (4.83%). These results are in agreement with **Cecilia and Maia (2002); Sangeetha *et al*. (2002**) and **Doreyappy-Gowda and Huddar (2001**); for stored apple juice, mango pulp and ripening mango, respectively. This decrease may be due to the formation of free acids and pectin hydrolysis.

Total acidity: The change in titratable acidity of mango concentrates recorded during storage at ambient temperature of (30±5º C) is showed in Fig. 3. Dibsha concentrate was reported maximum value of increased being 59.62% and Abu-Samaka concentrate was recorded minimum increased being 14.067%. These finding coincided with those **Germain *et al*. (2003**) and **Khan *et al.* (2012**) who reported the similar finding in mango pulp and mango juice. This increase in acidity may be attributed to the oxidation of sucrose, formation of acids by break down of polysaccharides and by degradation of pectic compounds and uronic acid (**Hussain *et al*. 2008).**

Sugars: Figs. 4 and 5 shows fluctuate trend in reducing and total sugars during storage, respectively. Generally, Galb-Altour and Shendi concentrates observed significant (P≤0.05) increased in reducing sugars of 2.25 and 58.36%. However, Kitchener reported maximum decreased (10.36%) and Dibsha recorded minimum decreased (0.97%). This result is agreement with results obtained by **Amin *et al*. (2008**) for mango fruits. The increase in reducing sugars of stored mango concentrates may be due to conversion of sucrose to glucose and fructose.

Organoleptic attributes: Addition of Chemicals preservative to the mango pulp improves their sensory characteristics and physical appearance (**Oms-Oliu *et al*., 2010** and **Kader, 2002)**.

Colour: Colour of food is main attribute for its visual appearance and judging the eatable quality. The effect of storage period on colour of mango concentrates is shown in Fig. 6. There were no significant (P≤0.05) differences between the five samples in colour, the mean scores of panelists for colour ranged from 60.4 to 54 during storage. Maximum mean score was observed in Dibsha concentrate (58.2), whereas minimum score was reported in Kitchener concentrate (49.4). This results are confirmed (**Durrani *et al.*, 2011 and Gliemmo *et al.*, 2009**) who reported the colour stability of mango pulp and pumpkin puree stored at ambient temperature, respectively. **Saini *et al*. (2000)** mentioned that the browning in mango pulp can be reduced by the application of potassium metabisulphite. The reduction in colour might be due to Maillard reaction accelerated during storage.

Flavour: The flavour of mango is affected by various conditions such as pre and post harvest, processing methods, type of packaging and storage conditions. Chemical preservatives are use in mango concentrate for a longer period of time with maximum retention of original flavour **(Younis *et al*., 2011**). The mean score of panelists for flavour were significantly (P≤0.05) decrease from 57.8 to 53 during storage (Fig. 7). For samples maximum mean score was obtained by Kitchener concentrate (61.8), while minimum mean score was reported in Abu-Samaka concentrate (45.2). **Hussain *et al*. (2003**) recorded similar results in mango pulp. In addition, These results are agreement with that suggested by **Raje *et al.* (1997**) for Alphonso mangoes stored at ambient temperature..

Taste: The mean score of judges for taste Significantly (P≤0.05) nearly unvaried (from 56.8 to 54) throughout storage period (Fig. 8). The maximum mean score was recorded in Dibsha concentrate (59.8), while the minimum mean score was reported in Abu-Samaka concentrate (49). This result are corresponding with **Hayat *et al.* (2005**) who reported that taste of Banky apple showed significantly decreasing trend with the passage of storage period.

Overall quality: the mean score of judges for overall quality were significantly (P≤0.05) decreased from 56.8 to 52.8 during storage (Fig. 9). Maximum mean score was reported in Dibsh concentrate (59), while minimum mean score was recorded in Abu-Samaka concentrate (43.4). In a similar investigate **Hashmi *et al*. (2007)** recorded that mango pulp preserved with potassium metabisulpite helps in controlling microbial growth and maintaining sensory characteristics.

Conclusion

It can be concluded that mangoes concentrates can play a remarkable role in the industry since it contains an excellent chemical composition and a good organoleptic attributes. On the other hand, additional of potassium metabisulphite as preservative in mango concentrates minimized degradation in colour, flavour and taste. In addition, observed best suitability and retain most beneficial by securing microbial safety, physcio-chemical stability and increases shelf-life to twelve months at ambient temperature.

Table 1: Physical properties of mango varieties*.

Variety	Parameters				
	Colour of peel	Weight (g)	Peel (%)	Stone (%)	Pulp (%)
Dibsha	Greenish yellow	661.75±3.53^{a}	19.37±0.06^{e}	7.84±0.01^{e}	60.44±0.0^{a}
Galb-Altour	Yellowish	400.40±5.66^{b}	24.37±0.18^{b}	17.57±0.09^{b}	47.93±0.1^{c}
Abu-Samaka	Yellowish orange	366.30±4.2^{c}	27.34±0.02^{a}	10.89±0.05^{d}	43.09±0.1^{d}
Kitchener	Yellowish	310.50±7.07^{e}	20.66±0.02^{d}	18.05±0.02^{a}	37.32±0.1^{e}
Shendi 1	Greenish yellow	3438.5±2.12^{d}	21.56±0.07^{c}	14.05±0.03^{c}	50.63±0.0^{b}

*Any two mean values having different superscript letters in each row differ significantly (P≤0.05).

Table 2: Microbiological evaluation of mango concentrates during storage at ambient temperature

Storage period	Test	Count (cfu /g)				
		Dibsha	Galb-Altour	Abu-Samaka	Kitchener	Shendi
3 months	Aerobic bacterial count	NIL	NIL	NIL	NIL	NIL
	Anaerobic bacteria count	NIL	NIL	NIL	NIL	NIL
	Coliform bacteria	NIL	NIL	NIL	NIL	NIL
	Flat –sour bacteria	NIL	NIL	NIL	NIL	NIL
	Spore -forming bacteria	3.0×10^{2}	NIL	NIL	NIL	NIL
	Yeast and moulds	NIL	NIL	NIL	NIL	NIL
.	.	.	.	.	.	.
.	.	.	.	.	.	.
↓	↓	↓	↓	↓	↓	↓
12 months	Aerobic bacterial count	NIL	NIL	NIL	NIL	NIL
	Anaerobic bacteria count	NIL	NIL	NIL	NIL	NIL
	Coliform bacteria	NIL	NIL	NIL	NIL	NIL
	Flat –sour bacteria	NIL	NIL	NIL	NIL	NIL
	Spore -forming bacteria	NIL	NIL	NIL	NIL	NIL
	Yeast and moulds	NIL	NIL	NIL	NIL	NIL

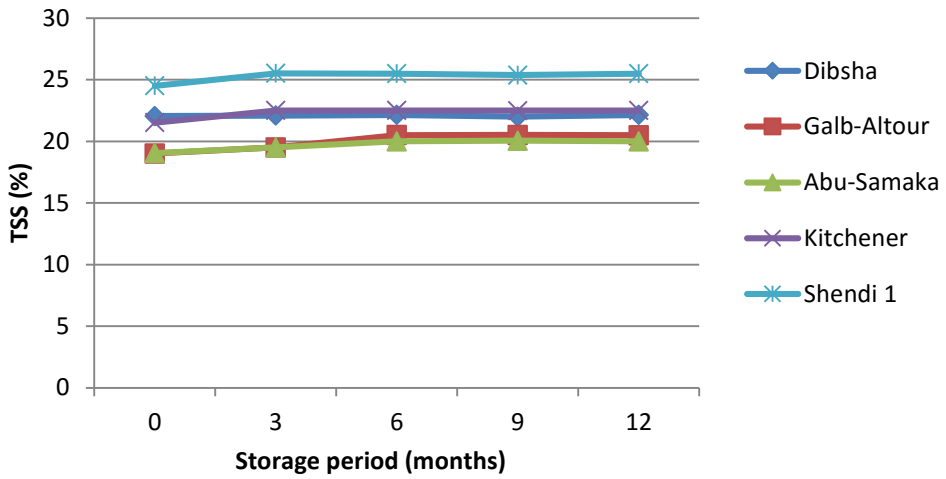

Fig. 1: Changes in TSS % of mango concentrates during storage

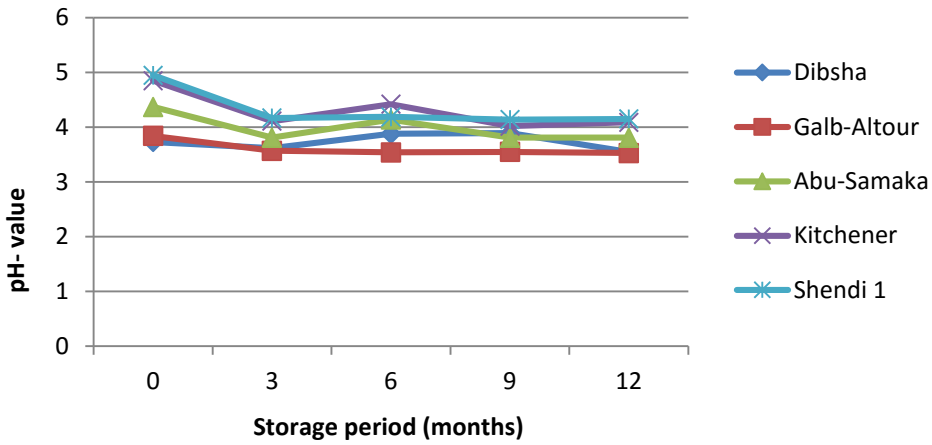

Fig. 2: Changes in pH-value of mango concentrates during storage

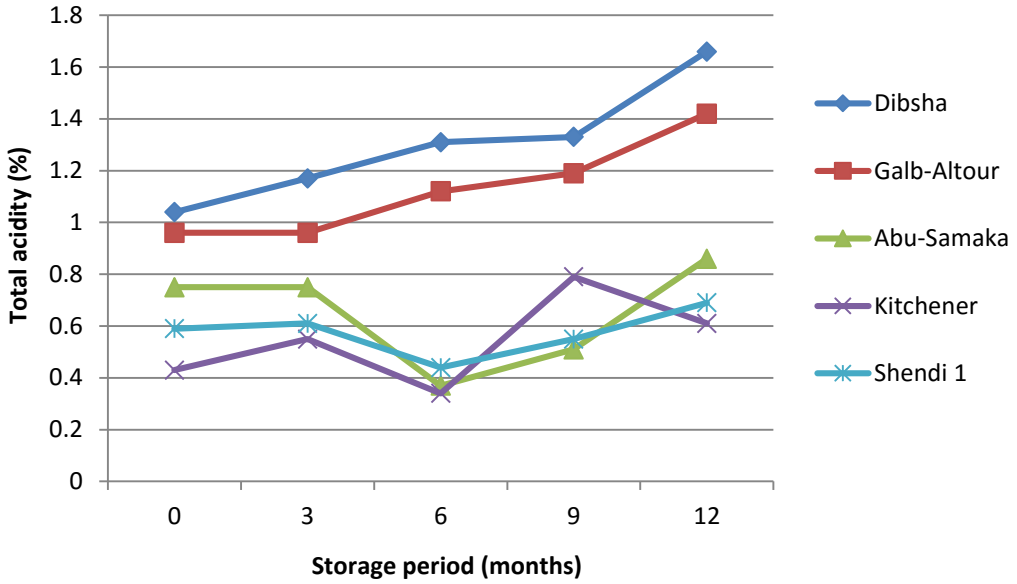

Fig. 3: Effect of storage period on total acidity% of mango concentrates

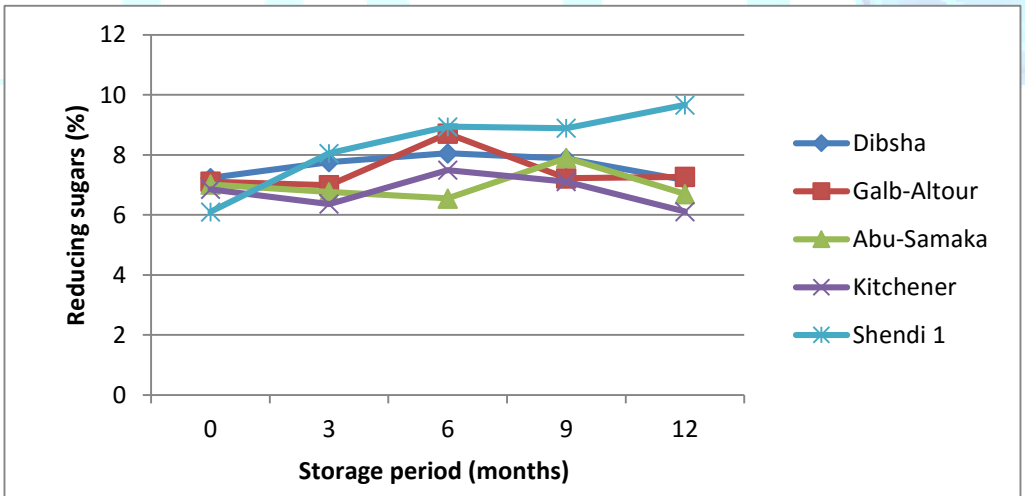

Fig. 4: Changes in reducing sugars % of mango concentrates duriing storage

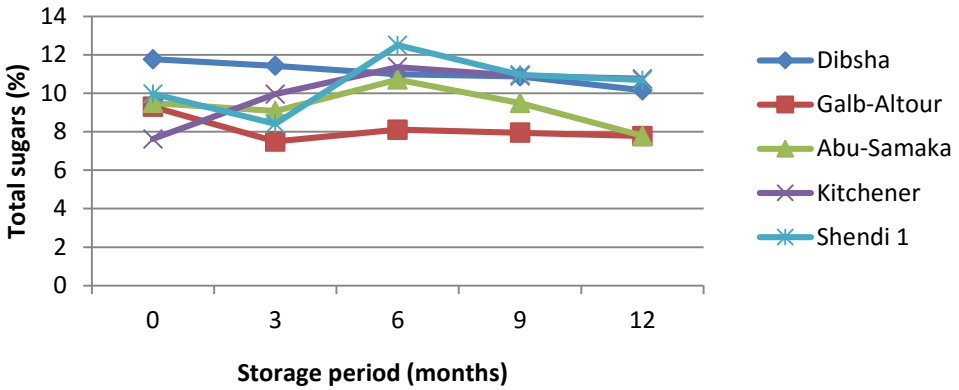

Fig. 5: Changes in total sugars% of mango concentrates during storage

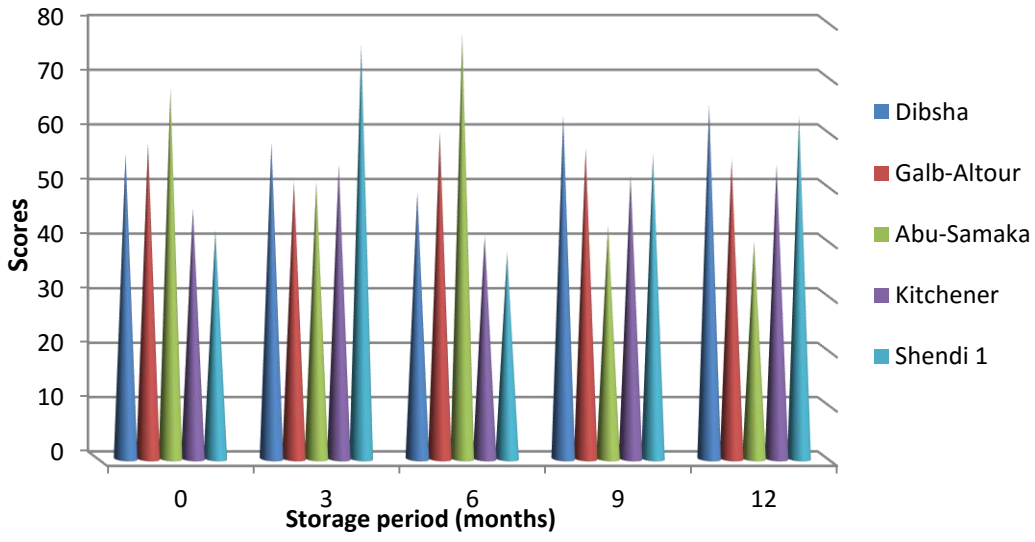

Fig. 6: Effect of storage period on colour of mango concentrates

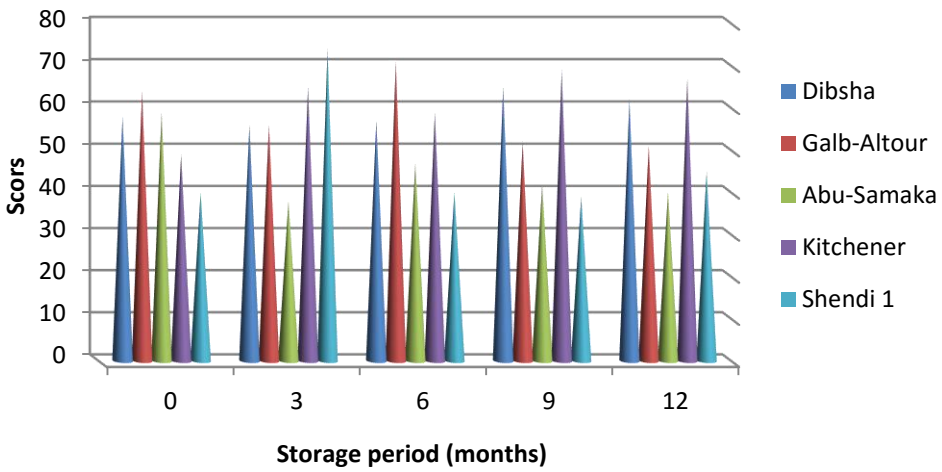

fig. 7: Effect of storage period on flavour of mango concentrates

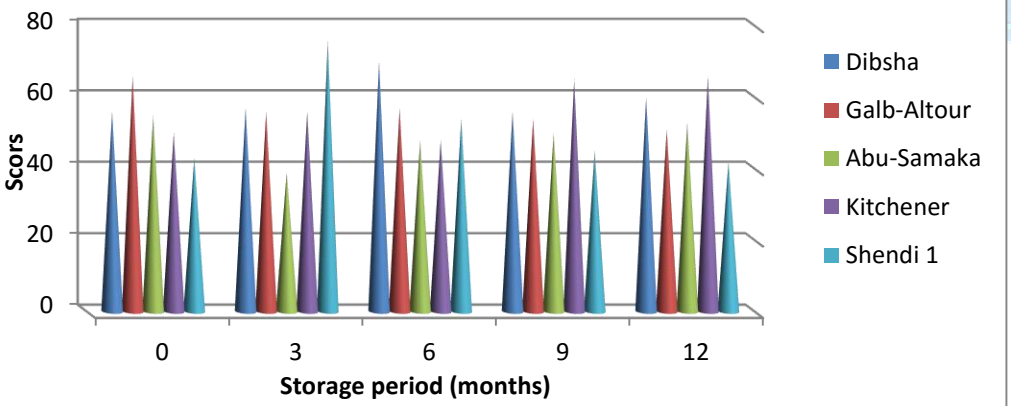

Fig. 8: Effect of storage period on taste of mango concentrates

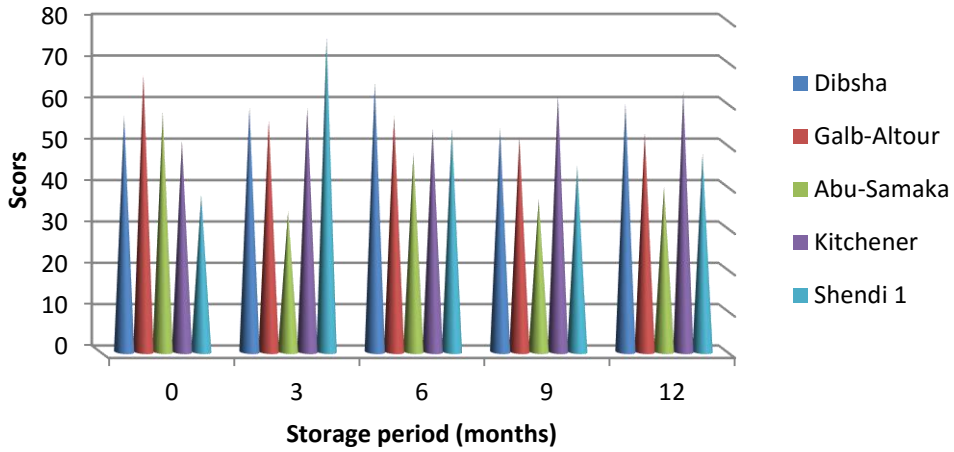

Fig. 9: Effect of storage period on overall quality of mango concentrates

References

Abdel-Rahman, N. A.; Ali, A. E. and Abdel Rahman, E. A. 2009. Physico-chemical evaluation of mango fruits from trees raised from seeds. Alzaiem Alazhri University. *The Scientific Journal*, (Sudan). **7**:119-132.

Abdel-Rahman, N. A.; Ali, A. E. and Elwasila, B. 2007. Characterization of Pectic Substances of Two Mango (*Mangifera indica L.*) Cultivars. *Journal of Food Science and Technology* (Sudan). 2:32-45.

Abdel-Rahman, N. A. (2002). *Characterization of Pectic Substances of Abu-Samaka Compared to Baladi Cultivar in Relation to Their Influence on Mango Pulp Concentrate*. Chapter 4. M. Sc. Thesis. University of Khartoum. Sudan.

Ali, M. A. and El-Faki, A. E. 2006. A comparison between a traditional and an advanced decortication method on the nutrients of sorghum (*Sorghum bicolor* L. Moench) grains. *Journal of Food Science and Technology* (Sudan). 1:31-43. (Cited from Ihekoronye, N. I. and Ngoddy, P. O., 1985. *Integrated Food Science and Technolgy for the Tropics*. 1st edition. pp. 180,181. MacMillan Publisher. London).

Amin, M.; Aman, U.M.; Mazhar, M.S. ; Islam, U.D.; Khalid, M.S. and Saeed, A. 2008. Mango fruit desapping in relation to time of harvesting. *Pakistan Journal of Biotechnology*. 40(4): 1587-1593.

AOAC. 2000. *Association of Official Agriculture Chemist*. Official Methods of Analysis. Assoc. of Analytical Chemist. 17th. Gaithersburg, DW. Washington. DC. USA.

Akhtar, S.; Mahmood, S.; Naz, S.; Nasir, M. and Sultan, M.T. 2009. Sensory evaluation of mangoes (Mangifera indica.L) grown in different regions of Pakistan. *Pakistan Journal of Biotechnology*. 41(6): 2821-2829.

Carrillo, L. A.; Ramirez-Bustamante, F.; Valdez-Torres, J. B.; Rajas-Villegas, R. and Yahia, E. M. 2000. Ripening and quality changes in mango fruit as affected by coating with an edible film. *Journal of Food Quality*. 23:479-486.

Cecilia, E. and Maia, GA. 2002. Storage stability of cashew apple juice preserved by hot fill and aseptic process. Deptment of Food Technology. University of Ceara, Brazil CEP.
Doreyappy-Gowda, L.N.D. and Huddar A.G. 2001. Studies on ripening changes in mango (Mangifera indica L.) fruits. *Journal Food Science and Technology*. Mysore. 38: 135-137.

Durrani, Y.; Alamzeb , Ayub, M.; Ullah, W. and Muhammad, A. 2011. Sensory evaluation of mango (Chaunsa) pulp preserved with addition selected chemical preservatives and antioxidant during storage. *Sarhad J. Agric.* 27(3):471-475.

FAO. 2007. *FAO statistical database*. Food and Agriculture Organization of the United Nations. Rome, United Nations. Avaliable from: http://faostat.fao.org.

Germain, K.; Benoi, B. K. and Israel, M .L. 2003. Effect of ripening on the composition and the suitability for jam processing of different varieties of mango (Mangifera indica) *African Journal of Biotechnology*. 2: 301-306.

Gliemmo, M.F.; Latorre, M.E.; Gerschenson, L.N. and Campos, C.A. 2009. Color stability of pumpkin *(Cucurbita moschata, Duchesne ex Poiret*) puree during storage at room temperature: Effect of pH, potassium sorbate, ascorbic acid and packaging material. LWT - *Food Sci & Tech*. 42:196–201.

Harrigan, W. F. 1998. *Laboratory Methods in Food and Dairy Microbiology*. Academic Press Inc, London.

Hashmi, M. S.; Alam, S.; Riaz A. and Shah, A. S. 2007. Studies on Microbial and Sensory Quality of Mango Pulp Storage with Chemical Preservatives. *Pakistan Journal of Nutrition*. 6 (1): 85-88.

Hayat, I.; Masud, T. and Rathore, H.A. 2005. Effect of coating and wrapping materials on the shelf life of apple (*Malus domestica cv. Borkh). Int'l. J. Food Safety.* 5: 24-34.

Hussain, I.; Zeb, A.; Sha I. kir, and Shah A.S. 2008. Combined effect of potassium sorbate and sodium benzoate on individual and blended juices of apricot and apple fruits grown in Azad Jammu and Kashmir. *Pakistan Journal Nutrition*. 7(1): 181-185.

Hussain, S.; Rehman, S.; Randhawa, M.A. and M. Iqbal, . 2003. Studies on Physico-chemical, microbiological and sensory evaluation of mango pulp storage with chemical preservatives. *J. Res. Sci. Pak*. 14 (1): 01-09.

Kader, A. A. 2002. Quality and safety factors: Definition and evaluation for fresh horticultural crops. *Postharvest technology of horticultural crops*. Univ. of California. 279–285.

Khan, R. U.; Afridi, S. R.; Ilyas, M.; Abid, H.; Sohail, M. and Khan, S. A. 2012. Effect of different chemical preservatives on the storage stability of mango-sea buckthorn blended juice. *Pak. J. Biochem. Mol. Biol*. 45(1): 6-10.

Mead, B and Gurnow, R. W. (1983). Statistical methods in agricultural experimental biology. Chapman and Hall, London, New York.

Ogiehor, S. I. and Ikenebomehclearly, M. J. 2004. Antimicrobial effects of sodium benzoate on the growth, survival and aflatoxin production potential of some species of Aspergillus in Garri during storage. *Pakistan Journal Nutrition*. 3: 300-30.

Oms-Oliu, G.; Rojas-Graü, M. A.; González, L. A.; Varela, P.; Soliva-Fortuny, R. and I. Hernando H. M. 2010. Recent approaches using chemical treatments to preserve quality of fresh-cut fruit: A review. *Postharvest Bio. and Tech*. 57: 139−148.

Oyarzabal, O.A.; Nogueira, M.C.L.; Gombas, D.E. 2003. Survival of Escherichia coli O157:H7, Listeria monocytogenes, and Salmonella in juice concentrates. *J. Food Prot*. 66: 1595–1598.

Raje, L.; Sherlekar, S.; Ramakrishnan, K.; lshe, M. V. C. and Subbulakshmi, G. 1997. Post harvest preservation of mangoes by controlled chemical release agents and adsorbent. *Acta Hort*. 455: 622-628.

Ranagana. S. 2000. *Manual of analysis of fruits and vegetables products*. Tata McGraw Hill Pub. Comp. Ltd. New Delhi.

Rathore, H. A.; Masud, T.; Sammi, S. and Soomro, H. 2007. Effect of storage on physico-chemical composition and sensory properties of mango (*Mangifera indica* L.) variety Dosehari. *Pakistan Journal of Nutrition*. 6(2):143-148.

Roy, A. K.; Joshi, s. and Nath, N. 1997. Effect of homogenization on sensory quality and rheogical characteristics of pulp and beverages from ripe “Deshehari” mangoes. *Journal of Food Science and Technology* (India), 34(3)212-217.

Saini, S.; Sogi D.S. and Bawa A.S. 2000. Shelf-life studies on chemically preserved sand pear (Pyrus pyrifolia cv patharnakh) pulp. *Journal of Food Science and Technology*. Mysore. 40: 230-232.

*Sangeetha, P. T.; Ramesh, M. N. and Prapulla, S. G. 2002. Influence of media components and reaction parameters on the production of fructosyl transferase and fructooligosaccharides. *Sciences des aliments*. 22: 277–287.

Srinivasan, N.; Elangovan, S. and Chinnaiyan, P. (2000). Consumer perception towards processed fruit and vegetables products. *Indian Economic Panorama*.10(3):11-12.

SSMO 2001. *Sudanese Microbiological Standards for Foods*: *Bottled, Natural and Formulated Juices*. No. 20. SDS 525. Sudanese Standards and Metrology Organization (SSMO). Khartoum. Sudan.

Thind, K. K.; Grewal, K. S. and Bakshi, A. K. 2002. Method of preparation and keeping quality of reconstituted skim milk based mango beverage. *Journal of Beverage and Food World*. 29(8):60-62.

Younis, M. S.; Butt, M. S.; Sharif, M. K.; Sulerai, H. A. R. and Hameed, F. 2011. Effect of preservatives on physicochemical, microbial and sensory attributes of mangoes. *Internet Journal of Food Safety*. 13:246-263.