

Effect of Chemical Preservatives and Storage Conditions on the Nutritional Quality of Tomato Pulp

Shampa Sarkar¹, Debashis Kumar Dutta Roy², Alomoni¹, Md. Abu Bakkar Siddik³, Kothika Das²,
Md. Jiaur Rahman^{1,4,*}

¹Department of Food Processing and Preservation, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh

²Department of Food Engineering and Technology, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh

³Institute of Nutrition and Food Science, University of Dhaka, Bangladesh

⁴Department of Biochemistry (MSc Student), Memorial University of Newfoundland, St. John's, NL, Canada

*Corresponding author: jia.hstu@yahoo.com

Abstract This study was conducted to investigate the effect of chemical preservatives and storage conditions on tomato pulp. Tomato pulps were prepared by using various concentrations of sodium benzoate (0.05 and 0.1%) and potassium metabi-sulphate (0.05 and 0.1%). They were also stored at 25°C, 4°C and -10°C and analyzed for lycopene, beta-carotene, ascorbic acid, acidity and total soluble solid (TSS). Results show that acidity was increased whereas lycopene, beta-carotene, TSS and ascorbic acid were decreased during storage period. These changes were more pronounced at 25°C than at 4°C and -10°C. Pulps treated with higher concentration of sodium benzoate were found to have minimal changes of chemical constituents at lower temperature as to higher temperature. The results revealed that higher concentration of sodium benzoate and storage at -10°C might be a better way for long term preservation of tomato pulp.

Keywords: *tomato pulp, preservatives, storage, nutritional quality*

Cite This Article: Shampa Sarkar, Debashis Kumar Dutta Roy, Alomoni, Md. Abu Bakkar Siddik, Kothika Das, and Md. Jiaur Rahman, "Effect of Chemical Preservatives and Storage Conditions on the Nutritional Quality of Tomato Pulp." *American Journal of Food and Nutrition*, vol. 3, no. 4 (2015): 90-100. doi: 10.12691/ajfn-3-4-1.

1. Introduction

Fruits and vegetables are most popular worldwide due to their nutritional value [32]. In recent years the production of fruits and vegetables has been increased. Consequently, fruits and vegetables could be used as value added products. Usually fruits are processed into juice, beverage, squash and syrups [35]. In addition, fruits by-products not only good source of bioactive compounds but also could be used as various value-added products [34].

Tomato (*Lycopersicon esculentum* Mill.) comes as one of the most important agricultural products among fresh vegetables in most countries in the world. Tomatoes have become more popular in recent decades. Tomato belongs to the *Solanaceae* family. As it is a relatively short duration crop and gives a high yield, it is economically attractive and the area under cultivation is increasing daily.

Tomato represents an essential part of human diet. It is a good nutritional resource rich in vitamin C and antioxidant mainly lycopene, carotenes, organic acids and phenolics. Tomatoes also contain tocopherol, lutein, folate, which could contribute to their beneficial effects [10,16,19]. In recent years, there has been a global trend toward the use of phytochemicals from natural resources such as vegetables, fruits, oilseeds and herbs, as antioxidants and functional ingredients [36]. Consumption of beta-carotene and lycopene, has been related to lower

incidence of cardiovascular disease and prostate, gastrointestinal and epithelial cell cancer [23,28,29].

Moreover, it possesses some proteins, carbohydrates, fats and minerals. In Bangladesh, lots of tomatoes are wasted due to lack of proper processing and preservation. During the peak season tomato sells at low prices due to larger supplies, resulting in less return to growers. But in off peak season tomatoes availability is so poor and price is so high which is unreachable to consumer. Tomatoes may be processed to give tomato juice and concentrated tomato juice, puree and paste. Tomato puree and paste may be marketed directly to the consumer or it may be an ingredient in other products, for example, tomato ketchup, soup, and sauces [8].

Drying is one of the oldest methods for the preservation of food products [33]. Many reports for the processing of tomato have been documented in literatures, such as canning [20], use of sun drying [5]. Several studies have been described the use of chemical preservatives such as sodium benzoate [22], and sodium Meta bisulfite [18], for preparation of tomato juice, paste and so on. Hossain *et al.* [12], found sodium benzoate had better additive as compared potassium metabi-sulfite and sorbic acid for preservation of tomato juice. It has been found lower temperature (4°C & -10°C) has more capable for retention of quality of tomato paste than higher temperature (20-40°C) [22]. However, scant studies have considered the joint effect of sodium benzoate and potassium metabi sulfite for preservation of tomato pulp.

Nowadays, with the spread of education, change in habits, growth in working women, the demand for processed vegetables/fruits is increasing progressively. So that tomato pulp could be used as safe and nutritious products throughout the year. Therefore, the main objective of this study are to investigate the effect of chemical preservatives such as sodium benzoate and potassium meta bi-sulfite and storage temperature (25°C, 4°C and -10°C) on nutritional quality of tomato pulp and determine the nutritional quality parameter of tomato pulp at different storage.

2. Materials and Methods

2.1. Sample Collection and Procurement of Materials

A local tomato winter variety was selected for the study. Full ripened fruits were obtained from local farm, which were uniform in size and color. The fruit was washed thoroughly with water to remove unwanted entities like dust, dirt, pesticides residues and surface microflora. Two preservatives sodium benzoate (NaC₆H₅CO₂) (Merck 6290) and potassium Metabisulphite (K₂S₂O₅) (Merck 106357) were purchased from dealers of local market.

2.2. Pulp extraction, Pasteurization, Packaging and Storage

After washing, the tomatoes were dried, blanched at 95°C for 5 min and processed immediately for pulp extraction. Extraction was done in an electric pulper where pulp was separated from the seeds and the obtained pulp was pasteurized in a water bath at a temperature of 82°C for 30 minutes. (At this temperature it is possible to completely kill spore forming bacteria which are sensitive to acidity of apricot pulp, with no changes in physical and chemical attributes) After pasteurization chemical preservatives (SB and PMS) as per treatment separately at 0.05% and 0.1% were mixed with the pulp. The treated pulp samples were then transferred to sterilized glass bottles and stored under ambient conditions (25°C), refrigerated (4°C) and freezing (≤-10°C) for a period of 150 days and assessed for chemical parameters at interval of 30 days.

2.3. Chemical analysis

2.3.1. Determination of Lycopene Content

Lycopene content of tomato pulp was measured by the method of Grolier *et al.* [9]. The sample (5-10 g) was extracted with acetone in a pestle and mortar. After that the acetone extract was kept in a separating funnel containing with 10 to 15 ml of petroleum ether and mixed gently. The colour pigment was discarded and extracted with petroleum ether and acetone and 5% Na₂SO₄. This process was continued until it became colorless. The color phase was transferred to a volumetric flask and measured the absorbance at 503nm by Spectrophotometer (TVT-300XPH, Sweden, Perten Instrument). Lycopene content was calculated by the following formula:

$$\begin{aligned} & \text{mg of lycopene per 100g} \\ &= \frac{\left(\frac{3.1206 \times o.D \text{ of sample}}{\times \text{Volume made up} \times \text{Dolusion} \times 100} \right)}{1 \times \text{Wt. of sample} \times 100} \end{aligned}$$

2.3.2. Determination of Beta-Carotene content

Beta-carotene was determined by Srivastava and Kumar [26]. Five grams of sample was extracted with 10-15ml acetone and added few crystal of anhydrous sodium sulfite. The residue was re-extracted until colourless. The solution was transferred into a separating funnel and washed with 10-15 ml petroleum ether. The lower phase was discarded and collected upper layer in a volumetric flask. After that volume was made 100 ml with petroleum ether and recorded absorbance at 452nm (TVT-300XPH, Sweden, Perten Instrument). β-carotene was calculated using the following equation:

$$\beta\text{-Carotene } (\mu\text{g}/100\text{g}) = \frac{o.D \times 13.9 \times 10^4 \times 100}{\text{Wt. of sample} \times 560 \times 1000}$$

2.3.3. Determination of Ascorbic Acid Content

Ascorbic acid was determined according to the method of Ranganna [21] with some modification. 10 to 20 ml of sample was extracted with 100 ml of 3% HPO₃ at room temperature. Then filtered the sample with a glass wool funnel. After that (2-10 ml) aliquot was taken and titrated against dye solution. Titration point was indicated by pink colour. Ascorbic acid content of the sample was calculated by following formula:

$$\begin{aligned} & \text{mg of ascorbic acid per 100g or ml} \\ &= \frac{\text{Titre} \times \text{Dye factor} \times \text{Volume made up} \times 100}{\left(\frac{\text{Aliquote of extract taken for estimation}}{\times \text{Wt. or volume of sample taken for estimation}} \right)} \end{aligned}$$

2.3.4. Determination of Titratable Acidity

Ten grams of sample was thoroughly mixed with distilled water. The mixture was then titrated by adding 0.1N NaOH until a pH of 8.1 was attained. The volume of the sodium hydroxide, added to the solution, was multiplied by a correction factor of 0.064 to estimate titratable acidity as percentage of citric acid monohydrate (g 100 g⁻¹) according to the AOAC (2002).

2.3.5. Determination of Total Soluble Solid (TSS)

Total soluble solids (TSS) content of all samples was determined using a digital refractometer (Model, PAL-Tea, ATAGO, Tokyo, Japan) and were expressed as degrees °Brix according to the AOAC (2002). All the readings were performed at 20 °C after filtration through hydrophilic cotton.

2.4. Statistical Analysis

Each experiment was done in triplicate. The results were expressed as mean ± standard deviation and were analyzed by SPSS (version 17.0 SPSS Inc). One-way analysis of variance was performed using ANOVA procedures. Significant differences between the means were determined by Duncan's Multiple Range test. P < 0.05 was considered as a level of significance.

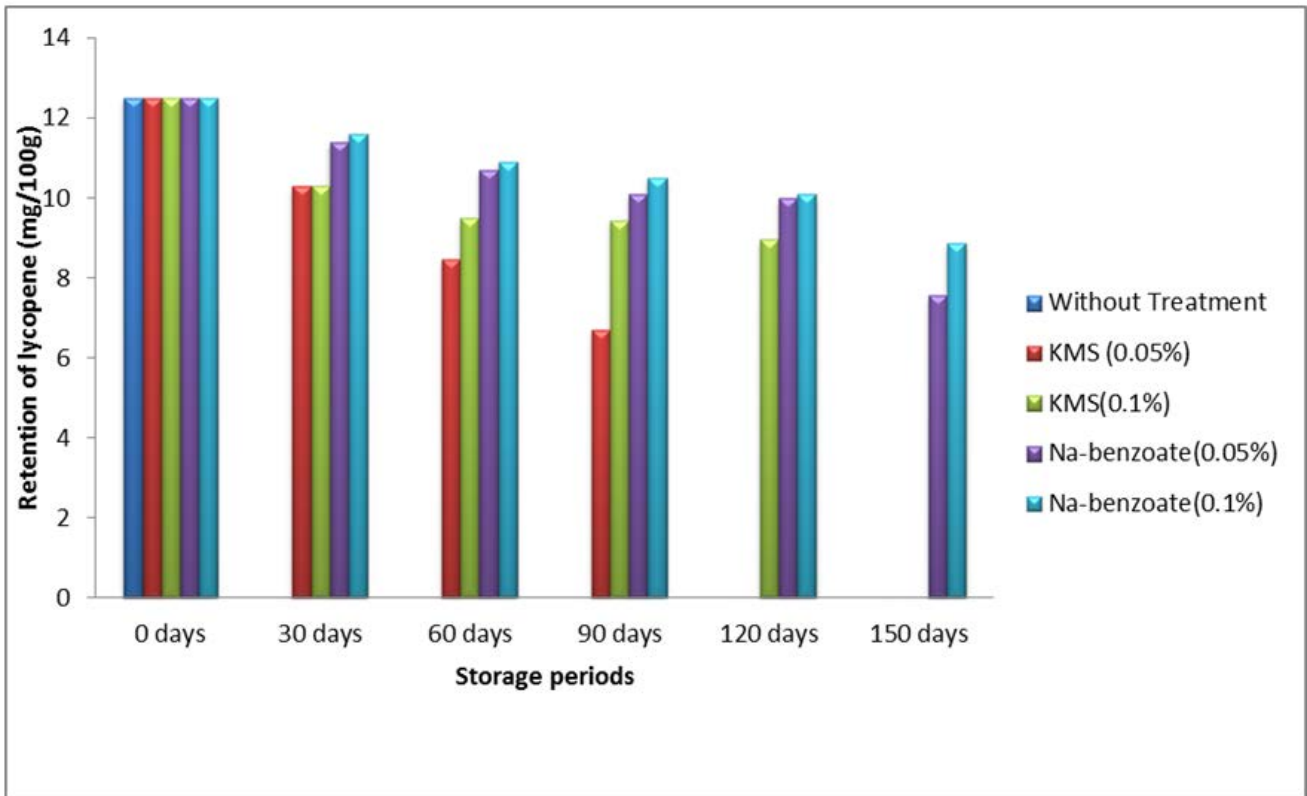


Figure 1. Effects of chemical preservatives on the retention of lycopene of tomato pulp during storage periods at 25°C

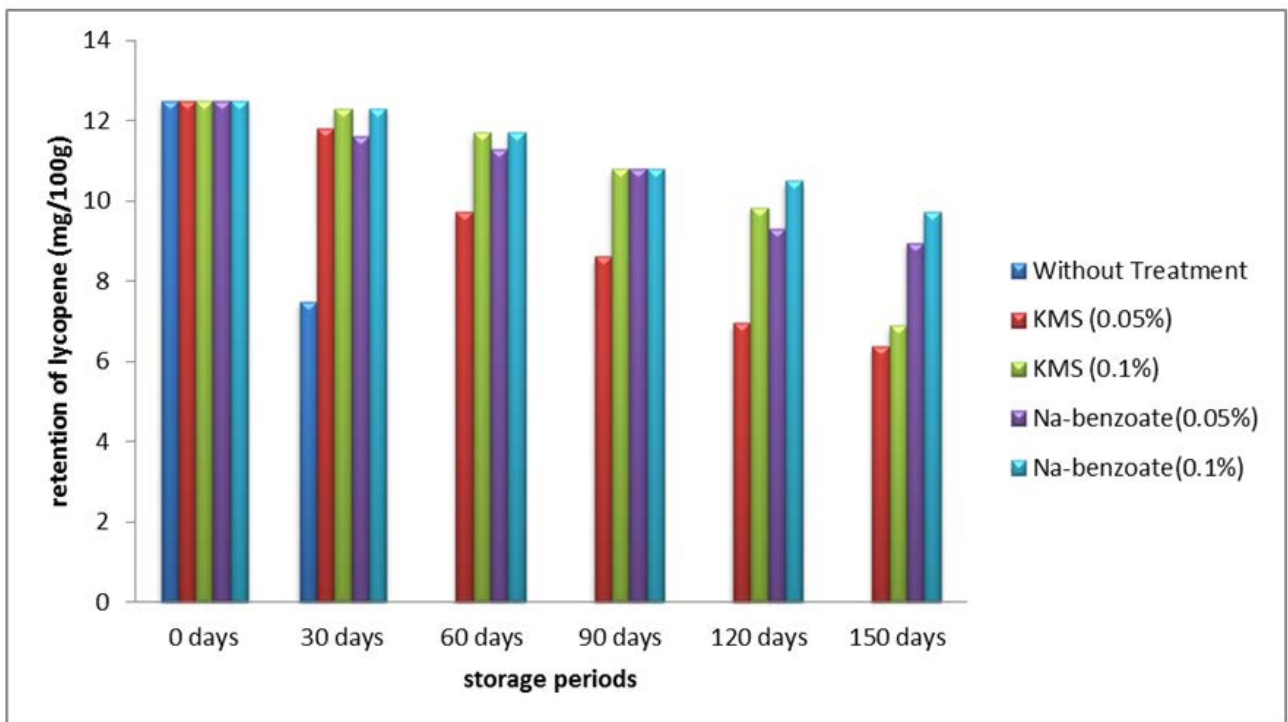


Figure 2. Effects of chemical preservatives on the retention of lycopene of tomato pulp during storage periods at 4°C

3. Results and Discussions

3.1. Effect of Preservatives and Storage Conditions on Lycopene, Beta-carotene and Ascorbic Acid

(Figure 1, Figure 2 and Figure 3) shows the effect of chemical preservatives, storage time and temperature on

lycopene content of tomato pulp. Lycopene retention was lowest in without treatment whereas treatment with preservatives recorded the higher lycopene. The retention of lycopene was higher in sodium benzoate compared to potassium meta bi-sulfite. This result is similar to Hossain *et al.* [12], who reported that sodium benzoate was better preservatives than potassium meta bi-sulfite and sorbic acid for tomato juice. Higher concentrations of preservatives were retained higher lycopene compared to

lower concentrations of preservatives. Lycopene content was decreased during storage period for all samples. However, ambient temperature (25°C) retained lycopene

content short time. The loss of lycopene at all conditions might be due to oxidation which depends on temperature, moisture etc [27].

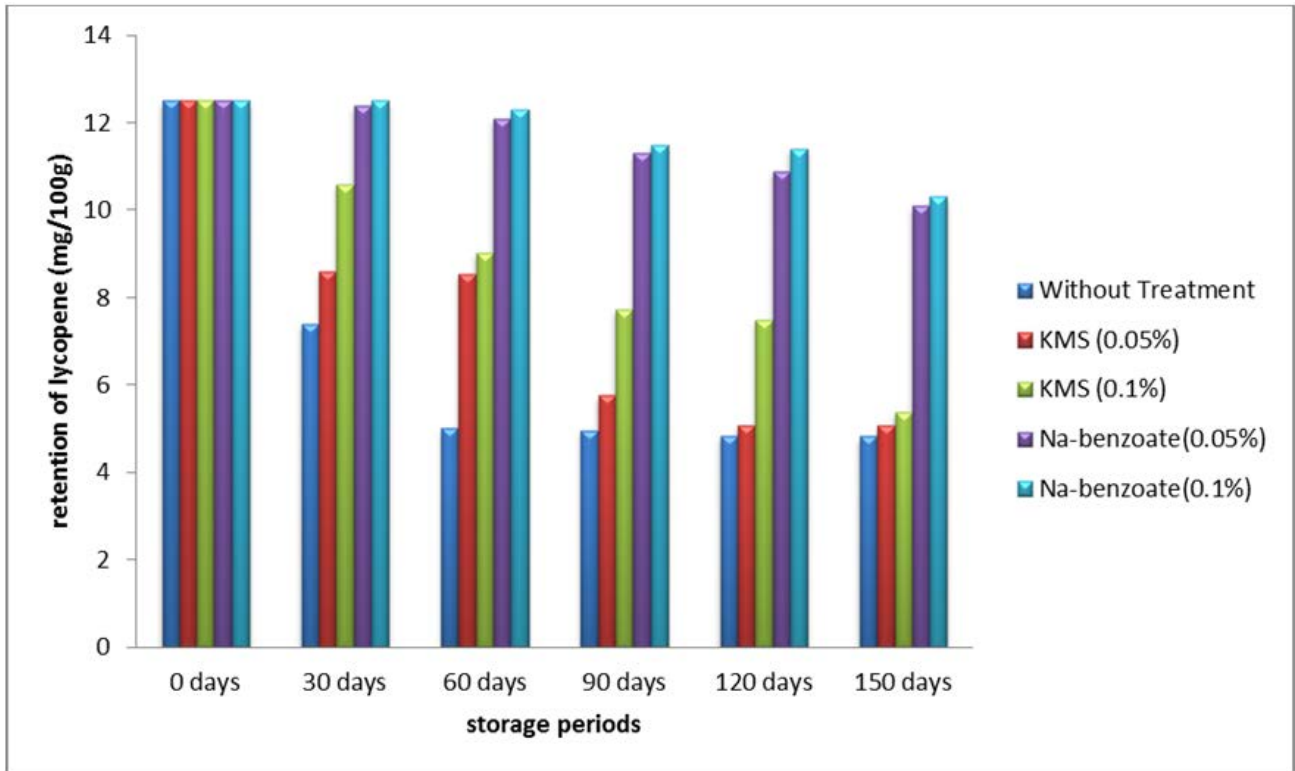


Figure 3. Effects of chemical preservatives on the retention of lycopene of tomato pulp during storage periods at -10°C

No significant difference observed between treatments (Figure 4, Figure 5 and Figure 6). Treatment with preservatives recorded higher beta-carotene whereas beta-carotene was lower in without treatment. Beta-carotene was reduced during storage periods for all samples.

Decreased of beta carotene (48.8%) was observed through the storage period. Variation of loss of beta carotene might be due to various processing treatments and storage condition. Freezing (-10°C) retained beta-carotene for long time compared to other storage conditions.

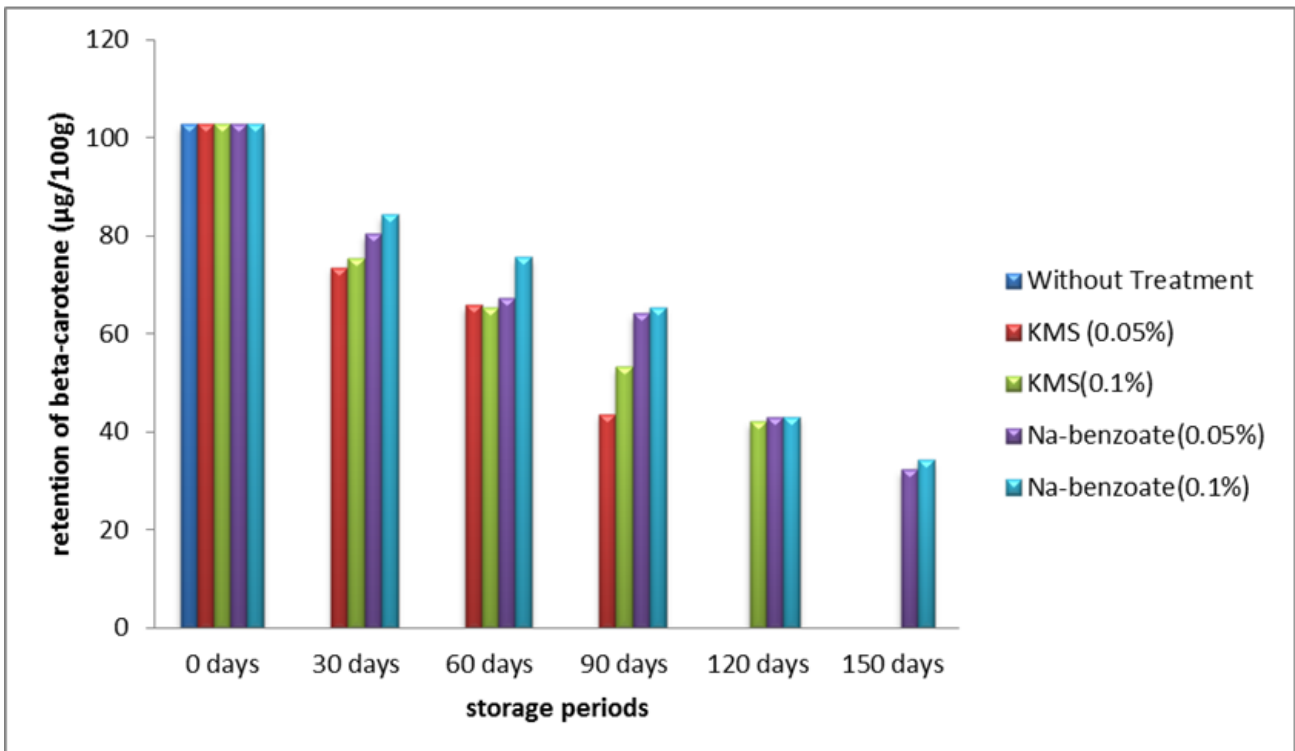


Figure 4. Effects of chemical preservatives on the retention of beta-carotene of tomato pulp during storage periods at 25°C

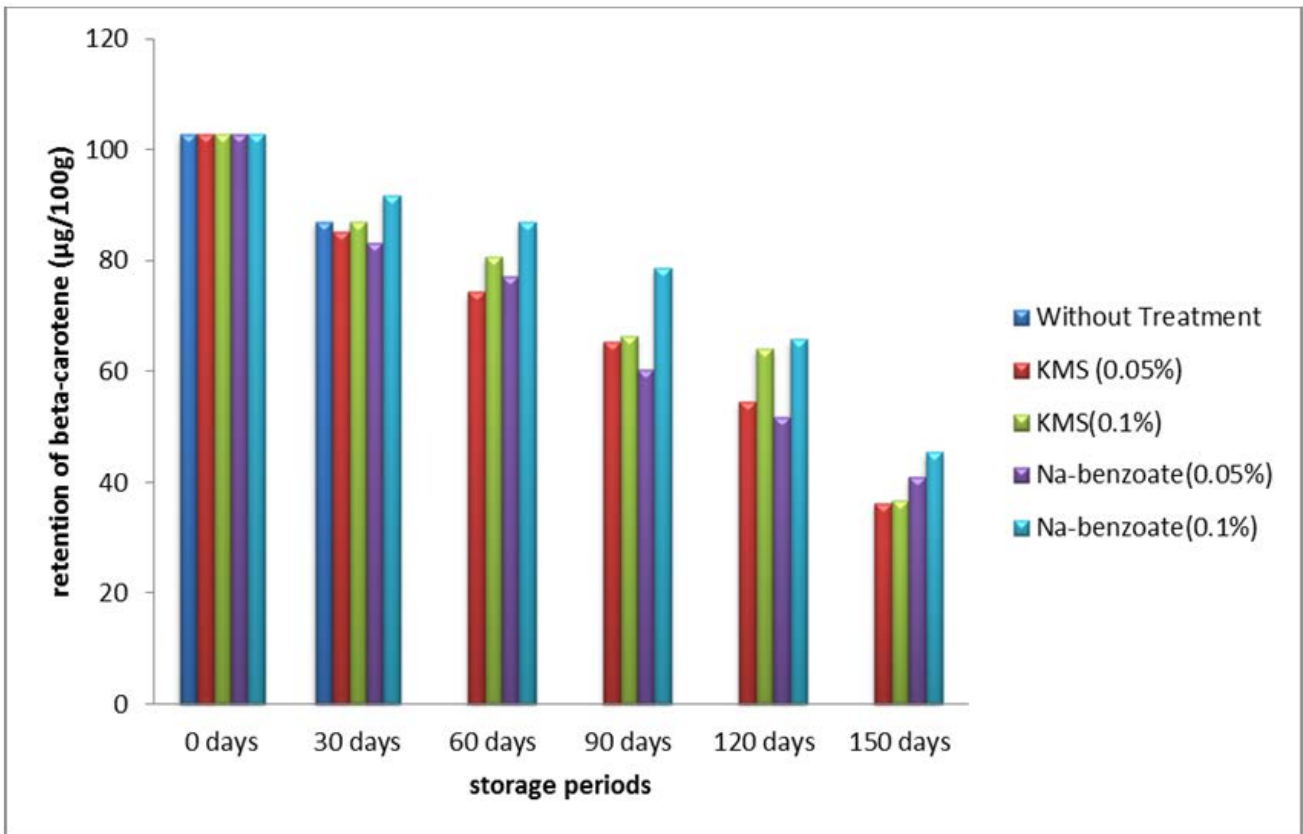


Figure 5. Effects of chemical preservatives on the retention of beta-carotene of tomato pulp during storage periods at 4°C

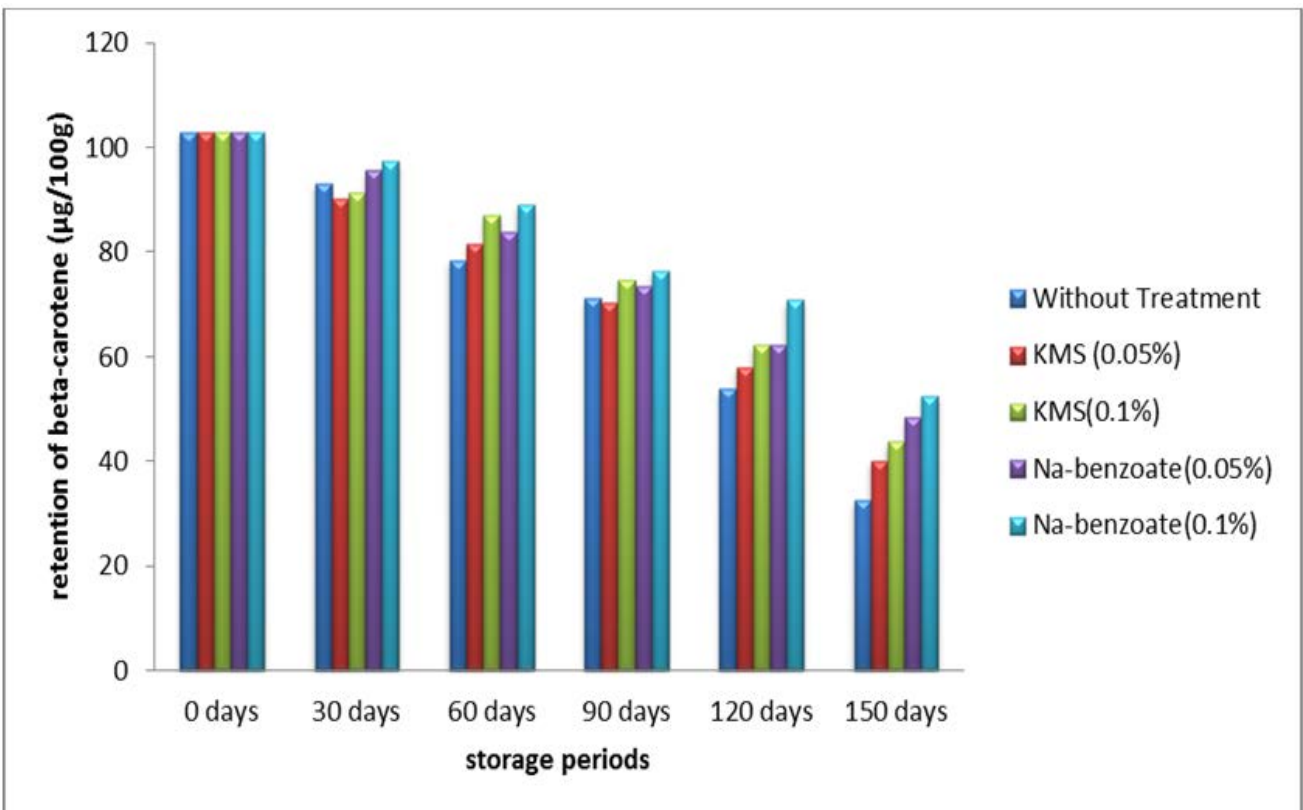


Figure 6. Effects of chemical preservatives on the retention of beta-carotene of tomato pulp during storage periods at -10°C

The effect of chemical preservatives, storage time and temperature on ascorbic acid content of tomato pulp is shown in figure (Figure 7, Figure 8, and Figure 9). Decline of ascorbic acid content was observed throughout

the storage periods at all temperature. Similar results were found in the study of Mehmood *et al.* [17], where ascorbic acid content was decreased with storage time in apple juice preserved with potassium sorbate and sodium

benzoate. Treated samples were retained higher ascorbic acid for longer time than untreated sample. Retention of ascorbic acid was higher at higher concentration of sodium benzoate at 25°C and 4°C. Freezing (-10°C) retained ascorbic acid higher as compared to refrigeration (4°C) and ambient temperature (25°C). The cause of

decrease of ascorbic acid at ambient temperature (25°C) and refrigeration temperature (4°C) due to oxidation which is greater at higher temperature. According to Smith and Hull [25] increased temperature normally results in high percentage loss of ascorbic acid.

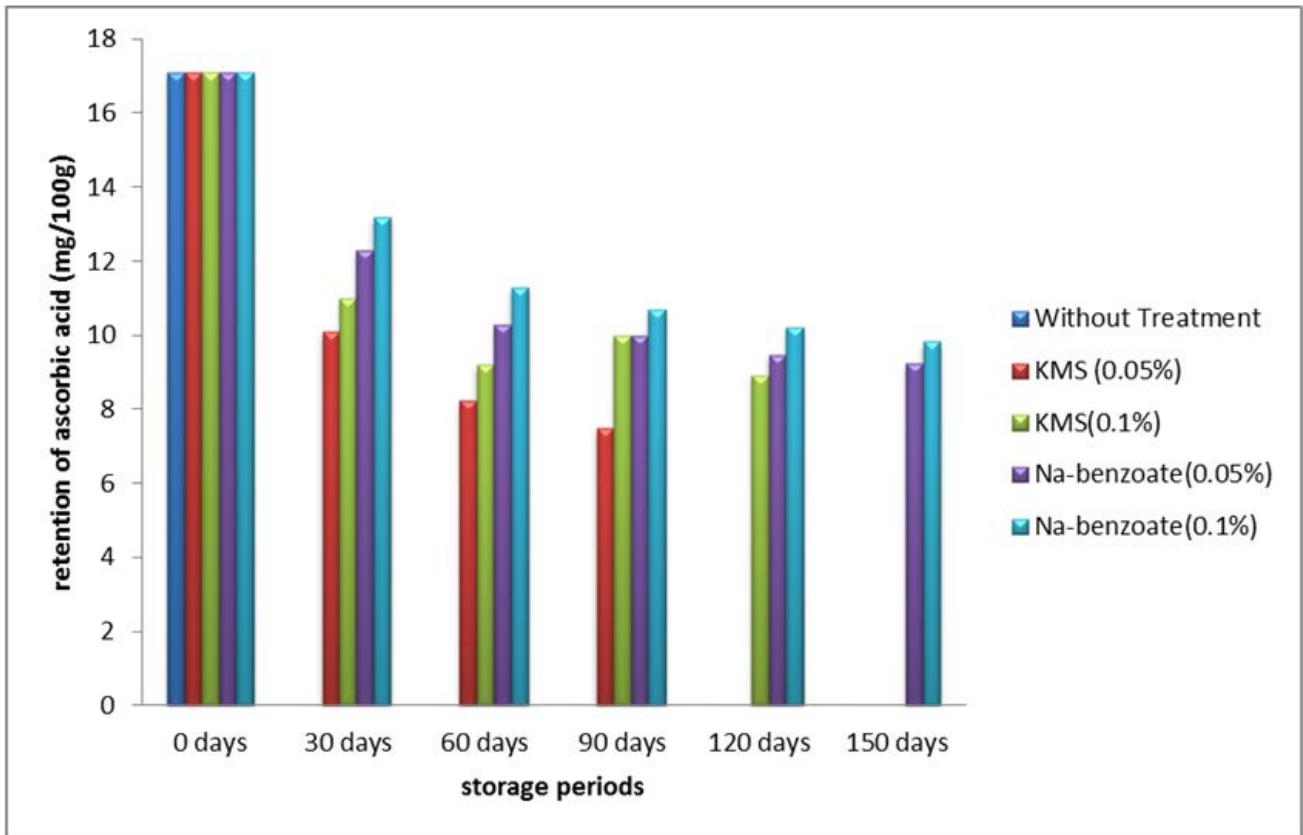


Figure 7. Effects of chemical preservatives on the retention of ascorbic acid of tomato pulp during storage periods at 25°C

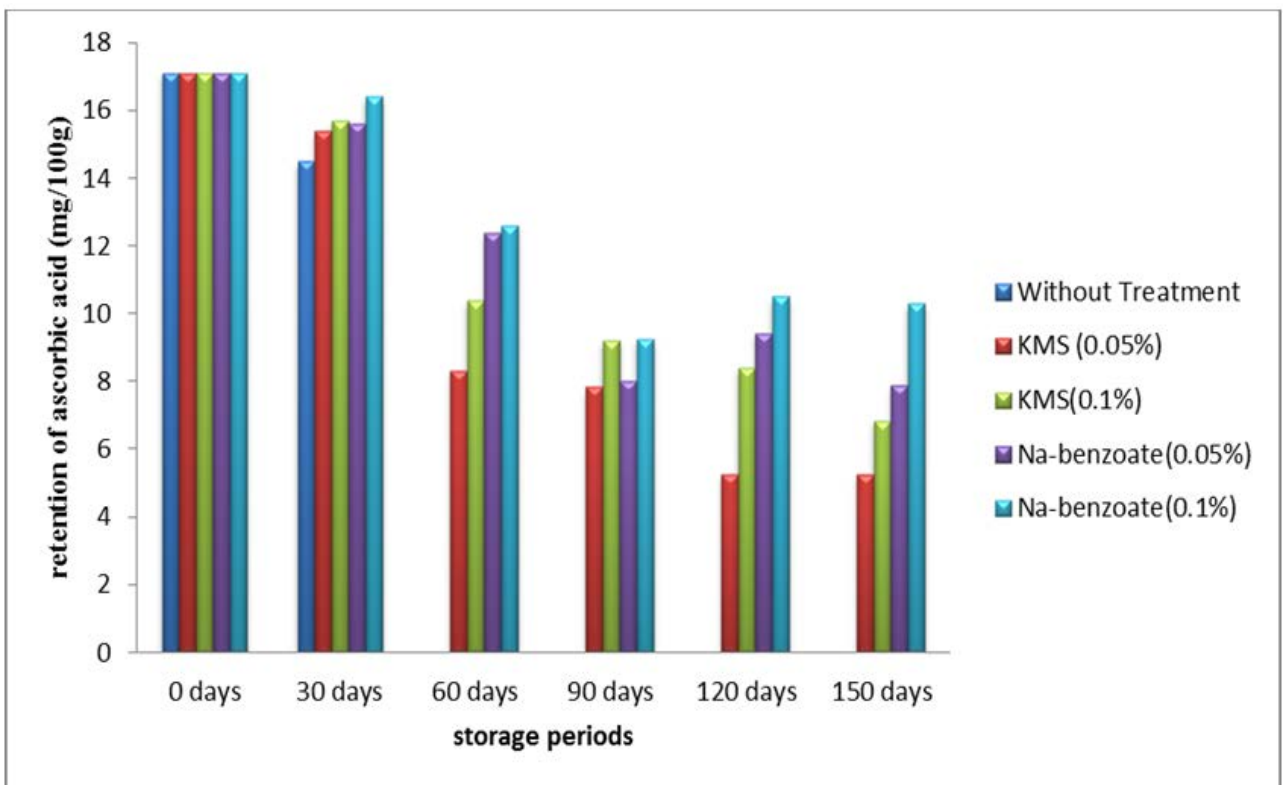


Figure 8. Effects of chemical preservatives on the retention of ascorbic acid of tomato pulp during storage periods at 4°C

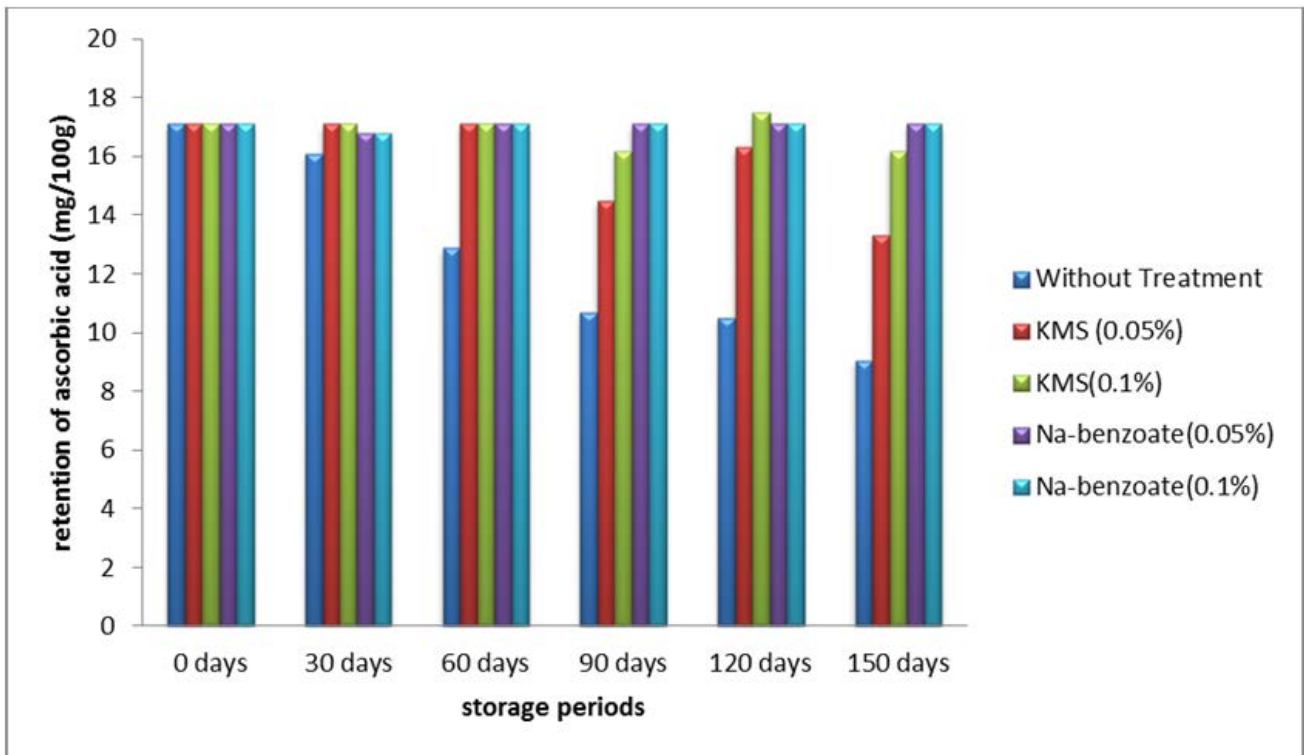


Figure 9. Effects of chemical preservatives on the retention of ascorbic acid of tomato pulp during storage periods at -10°C

3.2. Effect of Preservatives and Storage Conditions on Titratable Acidity

For all samples through the storage period, the titratable acidity was increased (Figure 10, Figure 11 and Figure 12). Acidity was increased higher at ambient temperature (25°C) and lower at freezing temperature (-10°C). It may

also be due to oxidation of alcohol and aldehyde during processing and is influenced by storage temperature, higher the temperature greater the increase in acidity [8]. No significant difference was observed between two preservatives and similar results were found between two concentrations of the preservatives. Increase of acidity was higher at untreated sample compared to treated sample.

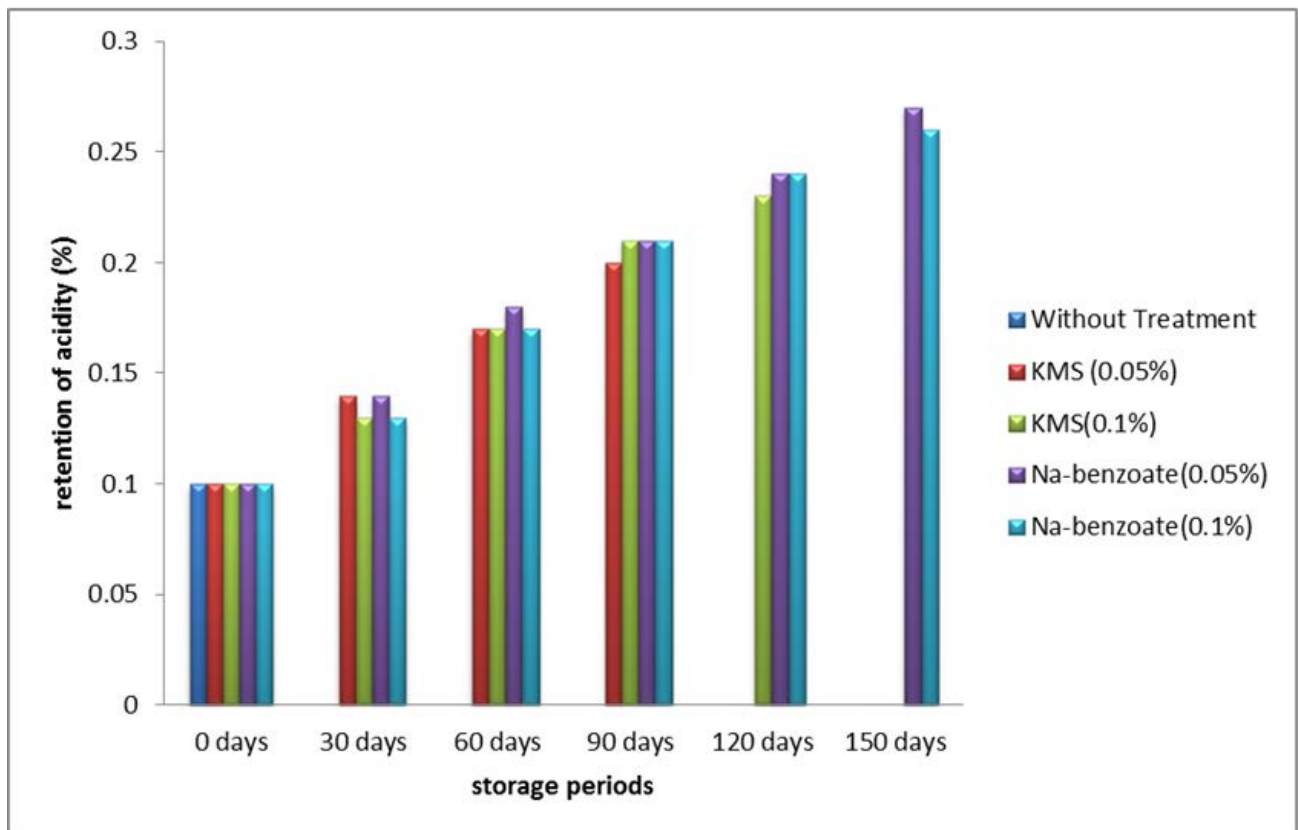


Figure 10. Effects of chemical preservatives on the retention of acidity of tomato pulp during storage periods at 25°C

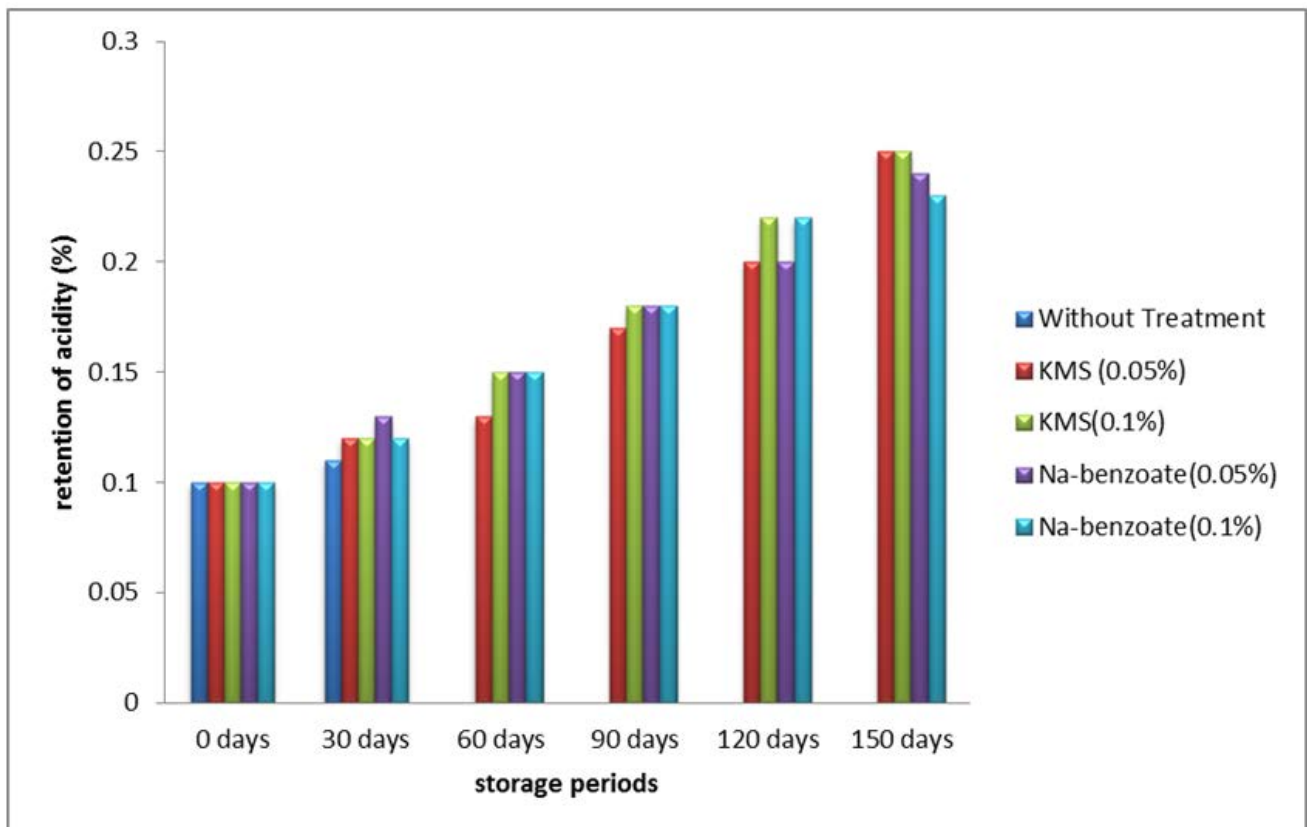


Figure 11. Effects of chemical preservatives on the retention of acidity of tomato pulp during storage periods at 4°C

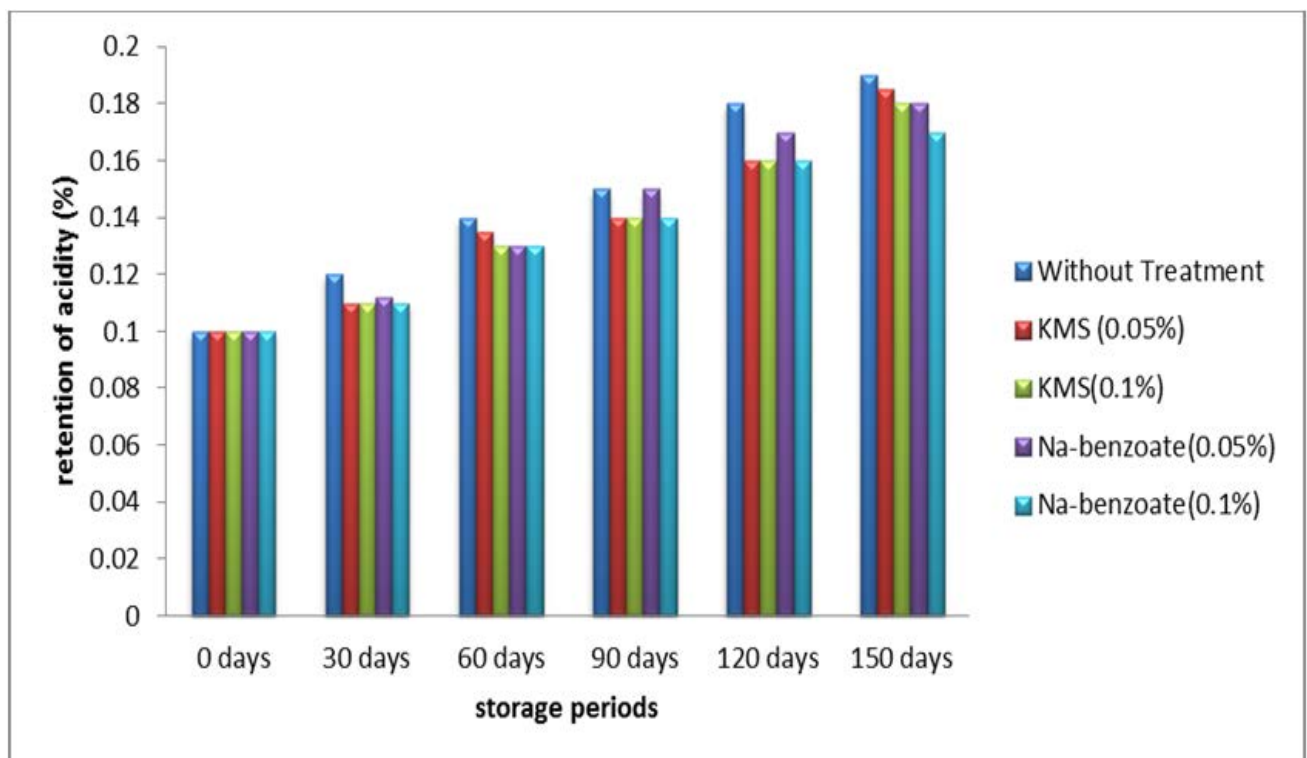


Figure 12. Effects of chemical preservatives on the retention of acidity of tomato pulp during storage periods at -10°C

3.3. Effect of Preservatives and Storage Conditions on Total Soluble Solid

The result of the effect of preservatives, storage temperature and storage conditions on the total soluble solid (TSS) are presented in the figure (Figure 13, Figure 14

and Figure 15). TSS content was decreased during storage period for all samples. Untreated samples were retained lower TSS as compared to treated samples. These treated samples were known to inhibit the growth and development of microorganisms and in ideal instance kill them [14,31]. This results also agree with Nwanekezi *et al.* [18], who reported that bottled tomato paste stored in air

tight bottles could be stored for long time using sodium meta bi-sulfite or sodium benzoate as preservatives. Although both preservatives can store tomato pulp for longer time with better quality but sodium benzoate retained higher TSS than Potassium meta bi-sulfite. Higher concentrations of preservatives were retained higher TSS compared to lower concentrations of preservatives. The total soluble solid of tomato pulp was decreased with storage temperature. Decrease in TSS was more in tomato pulp samples stored at higher temperature (25°C) than at

lower temperature (-10°C). The reason for this could be attributed to the higher storage temperature of the ones outside which could have led to increase in rate of spoilage, the bacteria (*Bacillus thermoacidurans*) probably being able to flourish better at this temperature. Another cause for the decrease could also be that the solids are probably broken down during storage. These observations agree with Ibrinke and Rotimi [13], who observed that with the storage time the rate of TSS of tomato powder was decreased outside greater than those in the fridge.

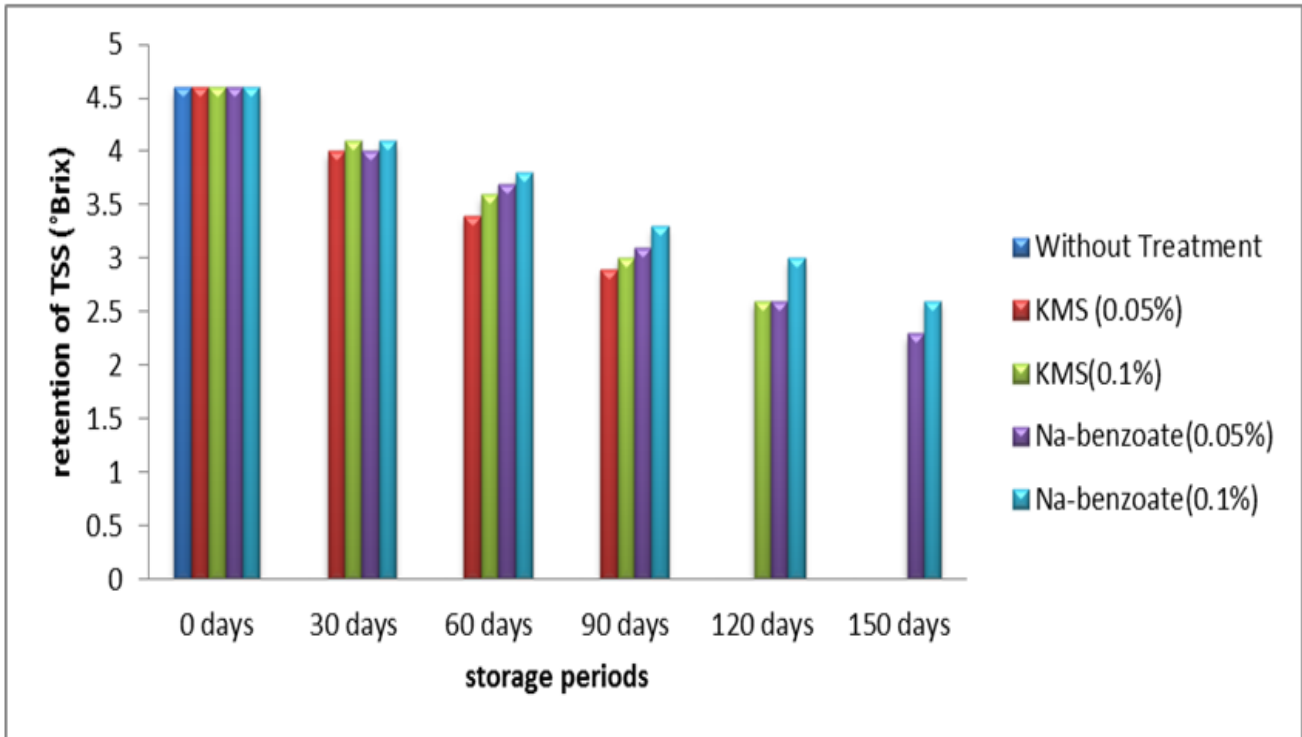


Figure 13. Effects of chemical preservatives on the retention of TSS of tomato pulp during storage periods at 25°C

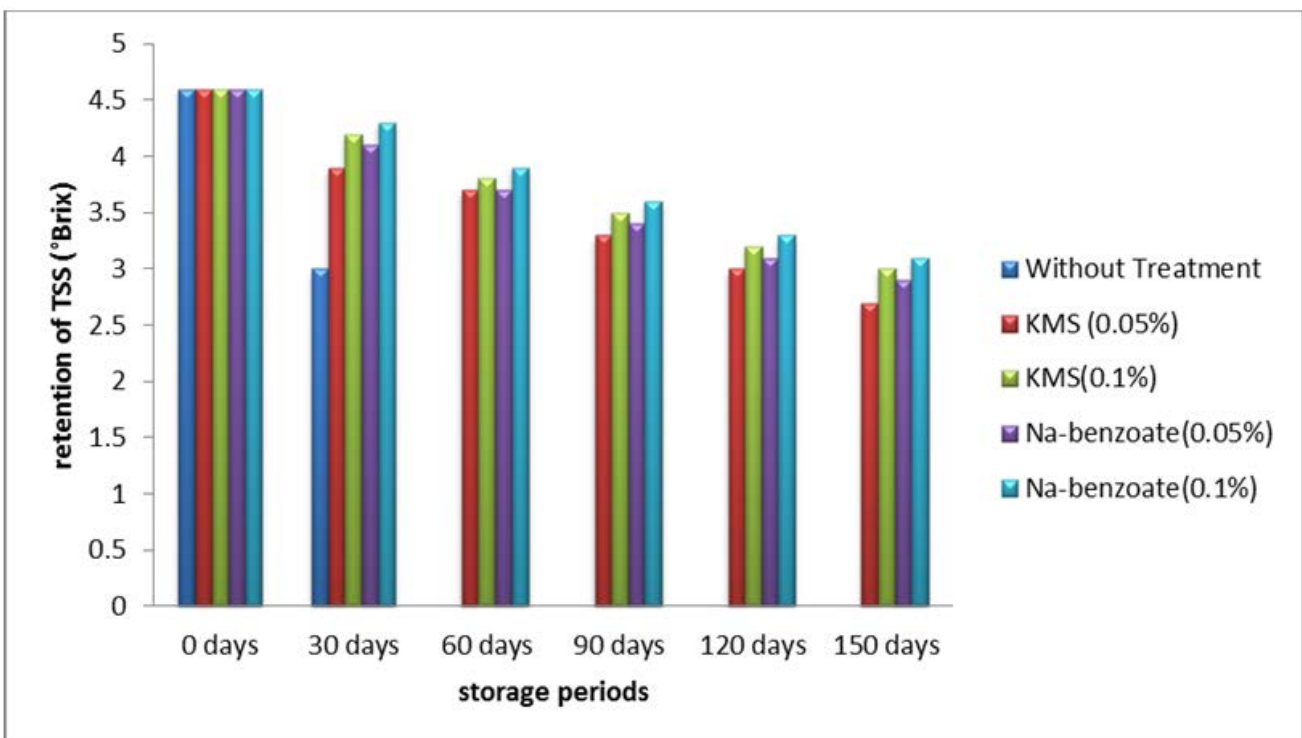


Figure 14. Effects of chemical preservatives on the retention of TSS of tomato pulp during storage periods at 4°C

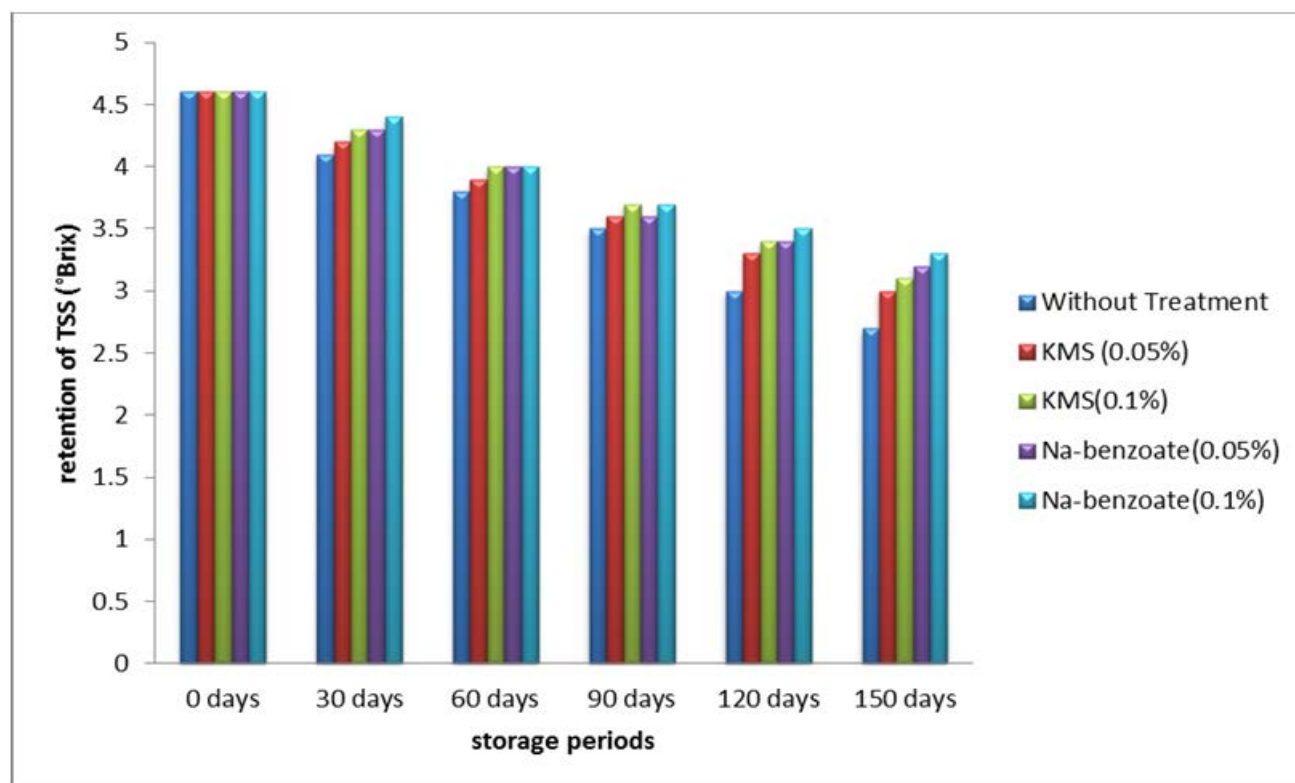


Figure 15. Effects of chemical preservatives on the retention of TSS of tomato pulp during storage periods at -10°C

4. Conclusion

The addition of various levels of sodium benzoate and potassium meta-bi-sulfite and storage condition on nutrition quality parameters of tomato pulp were investigated in this study. The lycopene, beta-carotene, ascorbic acid and TSS contents were higher and acidity was lower in tomato pulp with sodium benzoate as compared to potassium meta bi-sulfite and control. The samples with higher concentrations of sodium benzoate stored at -10°C found to last longer and its chemical constituents showed minimal changes over the period of study. So, it is concluded that tomato pulp could be stored for longer periods at -10°C treated with sodium benzoate.

References

- [1] Ahmed, K.U. (2008). Cultivation method of BARI released varieties. Bangladesh Agricultural Research Institute, Gazipur 1701, Bangladesh. p 85-96.
- [2] BBS 2009. Hand book of Agricultural Statistics, December, (2009). Bangladesh Bureau of Statistics (BBS). Ministry of Planning, Government People's Republic Bangladesh, p 14.
- [3] BBS (2010). Statistical Yearbook of Bangladesh. Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
- [4] Craft, N., Brown, E., and Smith, J. (1988). Effects of storage and handling conditions on concentration of individual carotenoids, retinol and tocopherol in plasma. American Association of Clinical Chemistry, 26: 15-25.
- [5] Eze, J. I. (2012). Studies on the effect of different solar driers on the vitamin content of tomato (*Solanum lycopersicon*). Journal of Food Processing Technology, 3:9.
- [6] FAO (2000). Database statistics.
- [7] FAO (2007). FAOSTAT : Statistical Database. <http://faostat.fao.org>.
- [8] Gould, W. A. (1992). In tomato production, processing and technology 3rd Edition. Baltimore, MD: CT Publications.
- [9] Grolier P., Bartholin G., Broers L., Caris-Veyrat C., Dadomo M., Di Lucca G., Dumas Y., Meddeens F., Sandei L., Schuch W. (2000). Les anti-oxydants de la tomate et leur biosynthèse In : Les anti-oxydants de la tomate et ses derives et leur bienfaits pour la santé. Le livre blanc de la tomate, Action concertée de la Commission Européenne, FAIR CT 97-32333 p.
- [10] Guil-Guerrero, J.L., and Rebolloso – Fuentes, M.M. (2009). Nutrient composition and antioxidant activity of eight tomato (*Lycopersicon esculentum*) varieties. Journal of Food Composition and Analysis, 22: 123-129.
- [11] Hayes, W. A., Smith, P.G., and Morris, A.E. J. (1998). The production and quality of tomato concentrates. Critical Reviews in Food Science and Nutrition, 38 (7), 537-564.
- [12] Hossain, M. N., Fakruddin M., and Islam, M. N. (2011). Effect of chemical additives on the shelf life of tomato juice. American Journal of Food Technology, 6(10): 914-923.
- [13] Ibrinke A. Ajayi and Rotimi A. Oderinde. (2013). Effects of different home storage conditions and preservation on some chemical constituents of tomato (*Lycopersicon esculentum*). Journal of Applied Chemistry, Volume 4, pp 19-29.
- [14] Ihekoronye, A. I. and Ngoddy, P.O. (1985). Integrated food Science and technology for the tropics. Macmillan Publishers Ltd., London and Basingstoke, p 137-138.
- [15] Li, X., F., Xiao, Q., Chen and Huang, B. (2000). The simultaneous determination of lycopene and beta-carotene in fruit, vegetables and plasma HPLC. Journal of Agriculture, 26: 444-446.
- [16] Martinez, V. I., Periago, M. J., Provan, G., and Chesson, A. (2002). Phenolic compounds, lycopene and antioxidant activity in commercial varieties of tomato (*Lycopersicon esculentum*). Journal of Agricultural and Food Chemistry, 82:323-330.
- [17] Mehmood, Z., Alam, Z., Mohammad, A., Nizakat, B., Amal and Ihsanullah, I. (2008). Effect of pasteurization and chemical preservatives on the quality and shelf stability of apple juice. American Journal of Food Technology, 3: 147-153.
- [18] Nwanekezi, E. C and Onyali, N. O. (2005). Effect of chemical preservation on the shelf life of bottled intermediate moisture tomato paste stored at ambient temperature. Nigerian Food Journal, 23: 0189-7241.
- [19] Periago, M. J., Garcia-Alonso, F. J., Jacob, K., Olivares, A. B., Bernal, M. J., and Iniesta, M. D. et al. (2008). Bioactive compound folates and antioxidant properties of tomatoes

- (*Lycopersicon esculentum*) during vine ripening. International Journal of Food Science and Nutrition, 12 : 1-15.
- [20] Raab, C. A. (2010). Canning Tomatoes and Tomato Products. A Pacific Northwest Extension Publication, Oregon state University, Washington. p 3-14.
- [21] Ranganna, S. (1991). Handbook of Analysis and Quality Control for Fruit and Vegetable Products. 2nd Edition. Tata McGraw Hill Publishing Company Limited., New Delhi.
- [22] Safdar, M. N., A. Mumtaz, M. Amjad, N. Siddiqui and T. Hameed. (2010). Development and quality characteristics studies of tomato paste stored at different temperature. Pakistan Journal of Nutrition, 9: 265-268.
- [23] Sesso, H. D., Buring, J. E., Norkus, E. P., Gaziano, J. M. (2004). Plasma lycopene, other carotenoids, and retinol and the risk of cardiovascular disease in women. American Journal of Clinical Nutrition, 79: 47-53.
- [24] Shah, A. S., Alam, S., Hashim, M. M., Hashmi, M. S., and Riaz, A. (2007). Effect of stabilizers and storage time on the overall quality of tomato paste. Sarhad Journal of Agriculture, Volume 23, No-4.
- [25] Smith, J. S and Hull, Y. H. (2004). Food Processing Principles and Applications. Blackwell Publishing Company, USA.
- [26] Srivastava, R.R. and Kumar, S., (1993). Important methods for analysis of fruits / vegetables and their products. Fruit and Vegetable preservation Principles and Practices 2nd Edition pp 321-339.
- [27] Trifiro, A.S., Gherardi, C. Z oni, A. Zanotti, M. Pistocchi, G. Paciello, F. Sommi, PL Arelli, MAM Anteguena. (1998). Quality changes in tomato concentrate production: Effects of heat treatment. Industrial Conserve 73(1): pp 30-41.
- [28] Walfisch, S., Walfisch, Y., Kirilov, E., Linde, N., Mnitentag, H., Agbaria, R., et al. (2007). Tomato lycopene extract supplementation decrease insulin like growth factor 1 levels in colon cancer patients. European Journal of Cancer Prevention, 16 (4) : 298-303.
- [29] Willcox, J.K., Catigani., G.L., and La Zarus, S. (2003). Tomatoes and cardiovascular health. Critical Review in Food Science and Nutrition, 43 :1-18.
- [30] Yadav, S., and Sehgal, K. (1995). Effect of home processing on ascorbic acid and beta-carotene content of spinach and amaranth leaves. Journal of Food Science, 2 : 125-131.
- [31] Potter, N. N. (1978). Food Science. 3rd Edition. Avi Publishing company Inc Westport Connecticut, p 649-647.
- [32] Rahman, M.J., Talukder, M.A.I., Hossain, M.F., Mahomud, M.S., Islam, M. A., and Shamsuzzoha, M. (2014). "Detection of *Cryptosporidium oocysts* in Commonly Consumed Fresh Salad Vegetables." American Journal of Microbiological Research, vol. 2, no. 6: 224-226. doi: 10.12691/ajmr-2-6-9.
- [33] Mahomud, M.S., Ali, M.K., Rahman, M.M., Rahman, M.H., Sharmin, T., and Rahman, M.J. (2015). "Effect of Honey and Sugar Solution on the Shelf Life and Quality of Dried Banana (*Musa paradisiaca*) Slices." American Journal of Food Science and Technology, vol. 3, no. 3: 60-66. doi: 10.12691/ajfst-3-3-2.
- [34] Noor, F., Rahman, M.J., Mahomud, M.S., Akter, M.S., Md. Aminul Islam Talukder, M.A.I., Ahmed, M. (2014). Physicochemical Properties of Flour and Extraction of Starch from Jackfruit Seed. International Journal of Nutrition and Food Sciences. Vol. 3, No. 4, pp. 347-354.
- [35] Azad, A.K. M., Ali, M. A., Akter, M.S., Rahman, M.J., Maruf Ahmed, M. (2014). Isolation and Characterization of Pectin Extracted from Lemon Pomace during Ripening. Journal of Food and Nutrition Sciences. Vol. 2, No. 2, pp. 30-35
- [36] Asaduzzaman, M., Haque, M.E., Rahman, M.J., Hasan, S. M. K., Ali, M. A., Akter, M. S., and Ahmed, M. (2013). Comparisons of physiochemical, total phenol, flavanoid content and functional properties in six cultivars of aromatic rice in Bangladesh. African journal of Food Science, Vol. 7(8) pp. 198-203.