Studies in physico -chemical properties of value added apple butter

Salaheddin Bashir Elbelazi [1], Vijay Bahadur Rajwade [2]and Nitin Sonkar[4]
Department of Horticulture, Sam Higginbottom Institute of Agriculture Technology and Sciences, (Deemed to – be –University) 211007, (U.P.) India.
Email: salah121267@yahoo.com

Abstract
The present investigation entitled " physic -chemical properties of value added apple butter " was carried out in Post-Harvest Lab, Department of Horticulture, Sam Higginbottom Institute of Agriculture Technology and Sciences, (Deemed to be University) during the winter season of the year 2012-2013 and 2013- 2014. The experiment was laid out in CRD with 10 treatments and 3 replications for preparation of apple butter From the present investigation it can be concluded that treatment T_6 (1.5 g spices + 3g citric acid \ kg apple pulp) proved to be the best in terms of quality whereas T_4 (1.5g spices + 2g citric acid\ kg apple pulp) proved to be best in terms of sensory score and T_5 (1.5g spices + 2.5g citric acid \ kg apple pulp). The microbial population (2.00 x 10-6cfu/g in T_0 and 1.00 x 10-6cfu/g in T_1) was not observed in any treatment except T_0 and T_1 in storage period of apple butter.

INTRODUCTION
Apple (***malusdomesticaBorkh***), belongs to family Rosacease, and sub family Pomoideae. The genus Malus has 17 basic chromosome numbers with somatic chromosome numbers with somatic chromosome number of 34, sometimes 51, 60&85. (**Wilcox, 1962**).

Amongst the various temperate fruit grown in the country, apple is the most important fruit which accounts for percent of total area and 75% of the total production of temperate fruits in the country**(CHANDHA 1992).** The major apple producing states of the India are Jammu and Kashmir, Himachal Pradesh, U.P.(North Hills) and Arunchal Pradesh.India is the second largest product of apple fruit, where as Jammu & Kashmir and Himachal Pradesh, U.P. (North Hills) and Arunchal Pradesh .India is the second largest producer (1158.3 m tones) of fruit is the country's largest apple producing state, contributing 94% of total produce. Its production is a 1622.085 mha and productivity 6.4mt/Ha.**(NHB Data Base-2011-12).**

Apple is highly nutritive food. It contains minerals and vitamins in abundance. The food value of the apple is chiefly constituted by its contents of sugar which ranges from 9 to 11% of this, fruit sugar constitutes 60% and glucose 25% and cane sugar only 15% per 100gm of apple contains moisture 84% protein 0.2% Fat 0.5% Minerals 0.3% Fiber 1.0% carbohydrates 13.4% among mineral and vitamins it contains 10 mg of Ca, 14mg of phosphorus and 1 mg iron per 100gm of fruit 100 gm of apple gives calorific values of 59 Calories. Thus fruit are an important supplement of the human diet as they possess almost all the nutritive components required for the growth and development of the human body leading to a healthy physique and mind. Also these are a ready source of energy with a unique capacity to guard against many deficiency diseases (**Sharma and Jindal, 1992).**
Apple is highly nutritive food. It contains minerals and vitamins in abundance. The food value of the apple is chiefly constituted by it's contents of sugar which ranges from 9 to 11% of this, fruit sugar constitutes 60% and glucose 25% and cane sugar only 15% per 100gm of apple contains moisture 84% protein 0.2% Fat 0.5% Minerals 0.3% Fiber 1.0% carbohydrates 13.4% among mineral and vitamins it contains 10 mg of Ca, 14mg of phosphorus and 1 mg iron per 100gm of fruit 100 gm of apple gives calorific values of 59 Calories. Thus fruits are an important supplement of the human diet as they possess almost all the nutritive components required for the growth and development of the human body leading to a healthy physique and mind. Also these are a ready source of energy with a unique capacity to guard against many deficiency diseases. Fruits and vegetables are highly perishable commodities- "as they are living tissues that are subject to continuous changes after harvest at this scale the post harvest losses are Rs. 6000 to 7000 crores per annum. Even if 10 % of this could be save by converting them into processed products at peak production season, there will be saving of Rs. 650 crores per annum to horticultural

wealth of the country. But processing industry at present is utilizing only about 1.8 percent of total production for processing **(NHB 2001- 2002).**

Apple is processed into few popular products like Jam preserve, chutney and cider; besides these products Apple has tremendous scope for the preparation of new products like cheese. In India very less work is carried out in apple preservation especially in case of cheese. It is highly nutritive, having good keeping quality, remunerative and has good export potential. Cheese is only one product which can be preserved for long duration and available trough out the year. Therefore it is very important to conduct research to develop the new recipes and for value addition from different cultivaters of apple. In preparation of apple cheese dry fruits such as cashew, almonds, peanuts etc. plays an important role in improving the nutrition value of apple cheese through value addition

MATERIALS AND METHODS

The present investigation entitled " Effect of small particles of dry fruits in physic -chemical properties of value added apple cheese " was carried out in Post-Harvest Lab, Department of Horticulture , Sam Higginbottom Institute of Agriculture Technology and Sciences, (Deemed to be University) Allahabad during the year 2013. Raw materials apple fruits were procured from the local market of Allahabad on first October 2013 bred at Allahabad then stored in the research Post harvest laboratory of Department of Horticulture, Sam Higginbottom Institute of Agriculture, Technology & Sciences (Deemed-to-be-University), Allahabad on the another day at room temperature the processed started with apple butter .

Apple butter preparation:

Selection fresh fruits washed fruits. Cutting and coring Boiling with equal quantity of water pulping and addition of sugar, Boiling Concentrating Addition of citric Addition of spices Boiling (until butter consistence) Judging of end point by further cooking up to 10 C or 68 -70 % TSS or by sheet test Remove from heat, Pour into clean sterilized bottles Cooling Waxing Capping Storage (at ambient temperature) in dry place at intervals 0, 30, 60 and 90 days. It was chemical analysis, sensory and microbial each storage period.

Physiochemical analysis

The total soluble solids in the samples were directly recorded by hand refractrometer and the results were expressed as per cent soluble solids (°Brix) and the values were corrected at 20°C. Product pH is measured by using an electronic pH meter. The pH meter was standardized by using buffers of pH 7.00 and 4.00 prior to recording pH of the samples. The Ascorbic acid and Acidity was determined by using as describe by **Larmond (1987).**

The titratable acidity (TA) of apple cheese was measured as described by **Maul *et al*. (2000**). The titratable acidity expressed as percent citric acid was obtained by titrating 10 ml of apple cheese with standard NaOH (about 0.1 N) to the end point (persisting for 15 s). The titratable acidity was then expressed as percent citric acid. On the other hand, the ascorbic acid content of tomato ketchup was determined using 2, 6-dichlorophenol indophenol method **(AOAC, 1970**). A 10-ml aliquot of apple cheese is diluted to 50 ml with 3 percent met phosphoric acid in a 50 ml volumetric flask. The mixture was titrated with the standard dye to the end point (persisting for 15 s). The ascorbic acid content was calculated from the titration value, dye factor and volume of the sample.

Sensory evaluation

Standard sensory evaluation procedures are followed to perform descriptive analysis; panelists were trained using repeated round table and individual evaluations of trial formulations of the control and value added samples. Hedonic scale method as described by **Steel (1997).**

Microbiological assay

The total microbial population was estimated using the procedure that had been followed by **Bracket (1990).** Apple butter samples were taken aseptically from each replication using pre-sterilized pipette and immediately subjected to serial dilution. Sample (1 ml) was serially diluted in 9 ml of 0.1% peptone water that was kept in the refrigerator. The serial dilution was done in the range of 10-1 to 10-5 series of test tubes. For the estimation of total aerobic bacteria, the sample of 1 ml was taken from the test tube aseptically using discrete pipette

and was plate on plate count agar **(Bracket, 1990).** Finally, all plates were incubated at 30°C for 2 days. The growth in bacteria was inspected after 2 days and the colonies were counted using standard colony counter. For the estimation of total coli form population, the sample of 1 ml was aseptically taken from the test tube using sterilized discrete pipette and was plate on duplicate violate red bile agar (VRBA) Finally, they were placed inverted and incubated at 37°C for 1 day. Afterward, the growth of coli forms was inspected and the colonies were counted using standard colony counter. For the estimation of fungi, the sample of 1 ml was aseptically taken from the test tube using sterilized discrete pipette and was placed on Rose-Bengal chloramphenicol agar base (oxoid CM549) **(Harrigan, 1998).** Then, they were placed inverted and incubated at 25°C for 3 to 5 days. The growth in yeast was inspected after 3 days and non growth plates were incubated for two days more to complete the recommended incubation period.

After Calculating the quantity of apple and aforementioned components added on following rates.

Spice.

1g of cinnamon, nutmeg and cloves. 1.5g of cinnamon, nutmeg and cloves 2gof cinnamon, nutmeg and cloves.

Preservatives .

2g citric acid/ kg apple pulp. 2.5g.Citric acid / kg apple pulp. 3g Citric acid / kg apple pulp.

Treatment combinations for value added apple butter.

Treatments	**Notations**
Control ((standard recipe only))	T_0
1g spice + 2g citric acid \ kg apple pulp	T_1
1g spices + 2.5 g citric acid \ kg apple pulp	T_2
1g spices + 3 g citric acid \ kg apple pulp	T_3
1.5g spices + 2g citric acid\ kg apple pulp	T_4
1.5g spices +2.5g citric acid \ kg apple pulp	T_5
1.5g spices + 3g citric acid \ kg apple pulp	T_6
2g Spices + 2g citric acid \ kg apple pulp	T_7
2g Spices+2.5g citric acid \ kg apple pulp	T_8
2g Spices + 3 g citric acid \ kg apple pulp	T_9

Flow chart of apple butter preparation:

Selection fresh fruits.
↓
Washed fruits.
↓
Cutting and coring
↓
Boiling with equal quantity of water
↓
Pulping
↓
Addition of sugar
↓
Boiling
↓
Concentrating
↓
Addition of citric and spices
↓
Boiling (until butter consistence)

↓

Judging of end point by further cooking up to 10 C or 68 -70 % TSS or by sheet test

↓

Removed from heat

↓

Pour into clean sterilized bottles

↓

Cooling

↓

Waxing

↓

Capping

Storage (at ambient temperature)

Statistical analysis

The data obtained was subjected to statistical analysis to find out the impact of storage period, different study materials and temperatures on the quality of the products during storage. A complete randomized design was applied for the analysis (Gomez and Gomez, (1984).

RESULTS AND DISCUSSION

Acidity

Acidity is an important attribute because tartness was a major factor in the acceptability of apple butter. Acid gives the characteristic sourness to the product. Citric acid was the major acid in apple that enhances the characteristic flavor of apple butter ready to serve was presented in (Table 1). Data showed that treated sample differ from control for the parameter of acidity. Highest acidity (0.87) was record in T_9 (2g Spices + 3 g citric acid \ kg apple pulp) while lowest (0.55) was observed in T_1(1g spice + 2g citric acid \ kg apple pulp)The data is found to reveal statistically at 0, 30, 60 and 90 days of storage The data regarding acidity in different treatments of This was gradual increase in acidity in all treatments during storage up to 90 days. Increase in per cent acidity might be due to the slight growth of micro-organism in the butter **Rangana (1991).** Similar finding have been reported by **Sogi andSingh**, **(2001)** in Kinnow Jam and Candy, The increase in acidity during the storage may be due to formation of organic acid by ascorbic acid degradation or the increase in acidity could have also occurred due to the hydrolysis of pectin are reported by **Aggarwal *et al.* (2014)** in kinnow candy.

TSS

The data on Total Soluble Solids (TSS) for all treatments has been presented in (Table 1) TSS of apple butter was found to increase with increase in storage duration. After 90 days of storage, the initial stage. The effect of treatments on TSS changes was observed significantly. The lowest mean TSS (65.54 °Brix) is recorded in T_0 (untreated control). while the highest TSS (76.13 °Brix) is observed in T_6 to inferior in improving the TSS level of the apple butter in all the treatments TSS was found gradually increased with increase in storage period. This might be due to the conversion of polysaccharides into sugars during hydrolysis process. Increase in TSS might also be attributed to the reduction in moisture content of the product with storage. Increase in TSS with storage was also by **Iftikhar *et al.* (2007)** in Apple and Pear Mixed Fruit Jam **and Yawin and Marsh (1999)** in apple butter.

pH

The pH has great importance to maintain shelf stability; pH can also influence the flavor and processing requirements of the apple Butter The data about pH (Table.(1) indicated that there was a variation in control and value added treatments The highest mean pH 4.43) observed in T_0 (untreated control) . While the lowest mean pH (3.05) was observed in T_6 Increase might be due to the slight growth of micro-organism in the beverage. The data about pH was clear in (Table. 3) **Rangana (1991).** Similar results were reported by **Ehsan *et al.* (2003)** in case of grapefruit apple marmalade and **Ali Muhammad. *et al.* (2008)** in apple jam.

Ascorbic acid

Marginal differences in ascorbic acid contents were observed in various treatments. Treated samples also differed from control samples with respect to ascorbic acid contents (Table 1). Statistical Analysis showed that the results were highly significant for storage period. Ascorbic acid contents decreased significantly at all storage intervals. These losses of ascorbic acid were attributed to the effect of processing, storage time and exposure to light. Highest ascorbic acid (6.82) is record in T_9 (6.82) and (19.4%) followed by T_8 (6.70). While lo west (4.95) was observed in T_0 (Control). The degradation of ascorbic acid in apple butter may follow aerobic and an-aerobic pathways. The ascorbic acid content in apple butter was showed decreasing trend in all values addition. Similar has been reported in ascorbic acid during storage were in conformity with the results obtained by **Sogi and Singh (2001)** development in Kinnow juice, ready-to-serve, squash, jam and candy and **Jawaheer (2003)** processing and storage of guava into jam and juice on the ascorbic acid content.

Colour and appearance

The data on effect of additive on Colour and appearance of apple butter stored at room temperature are shown in Table (2). The data was found statistically significant at 0, 30, 60 and 90 days at storage. The Colour and appearance was probably due to setting abilities of different value added apple butter prepared from different value additive. Pectin present in the fruit was responsible for setting the value added apple butter more pectin content means early end point and less cooking The effect of treatments on Colour and appearance apple butter in Table (2). T_4 (1.5g spices + 2g citric acid\ kg apple pulp) ranked highest for Colour and appearance this (7.51 score) was followed by T_5(1.5g spices +2.5g citric acid \ kg apple pulp)(7.00 score) T_0(Control) was (2.12 score) ranked lowest as regard to its Colour /Appearance characteristics. Storage had a significant effect on Colour perception of apple butter. The ranked highest for Colour and Appearance were observed when it was freshly prepared in T_4 (1.5g spices + 2g citric acid\ kg apple pulp). These findings are in confirmative with reports of **Ehsan ELahi Bajwa *et al.* (2003), Ali Muhammad. *et al.* (2008)** storage period increased, a slight decline in Colour and Appearance score.

Texture/ body

The data on effect of value additive material on texture of apple butter stored at room temp was shown in Table (2). The data was found statistically significant at 0, 30, 60 and 90 days of storage. The texture showed increasing trend in all treatment. Texture and body of the apple butter is affected significantly by treatments. T_4 (1.5g spices + 2g citric acid\ kg apple pulp)got (7.37 score) the maximum score for texture and body is followed by (6.91score)T_5 (1.5g spices +2.5g citric acid \ kg apple pulp) The lower texture and body perception (1.91 score) was recorded in T_0 (Control). A significant variation was observed in flavor perception of apple butter .The texture was directly related to the setting of product and setting was a result of good pectin. These results coincide with the studies conducted by **Hiremath *et al.* (2012)**, **Aggarwal (2014)** in kinnow candy.

Flavour/ taste

In organoleptic evaluation flavor and taste was very important factor after colour and texture. Statistical Analysis revealed a significant effect The data on effect of additive food material on flavor of apple butter stored at room temperature shown in Table (2) The data was fond statistically significant at 0, 30, 60 and 90 days of storage. In organoleptic evaluation flavor and taste was very important factor after Flavour and taste. Statistical Analysis reveal a significant effect of treatment and storage on flavor and taste apple butter T_4 (1.5g spices + 2g citric acid\ kg apple pulp) sample (7.44 score) got higher scores of flavor and taste was followed by (7.28score) T_5 (1.5g spices +2.5g citric acid \ kg apple pulp) The lower on flavor and taste (2.11score) was recorded in T_0 (Control). An appropriate combination of acid and sugar result in the product with a good taste. The same quantity of sugar and acid was added to all the treatment. These finding are conformity with the reported of **Ali Muhammad *et al.* (2008), Anjali *et al.* (2005)** in Sapota Candy.

Overall acceptability

The data on effect of value additive on overall acceptability of apple butter stored at room temperature are shown in Table (2). The data was found statistically significant at 0, 30, 60 and 90 days of storage. Overall acceptability was influenced significantly with the treatment. Higher level of could not produce top acceptability due to deviation from standard Colour, Texture, Flavor of the product retained after 90 Days of storage The overall acceptability showed increasing trend in all treatment. The initial overall acceptability was recorded of storage among the

different additive the maximum score (7.44) was observed in T_4 (1.5g spices + 2g citric acid\ kg apple pulp) followed by (6.97) T5 (1.5g spices +2.5g citric acid \ kg apple pulp) and minimum change (2.07) is observed in T_0 control (standard recipe only). However the organoleptic characters showed a gradual increase during the storage period up to 90 days. This finding was in conformity with **Singh**. ***et al.* (2006)** in guava cheese up to 90 days at storage and decrease therefore, **Hiremath *et al.* (2012)** and **Anjali *et al*.(2005).**

CONCLUSION

From the present investigation it can be concluded that treatment T_6 (1.5g spices + 3g citric acid \ kg apple pulp) proved to be the best in terms of quality whereas T_4 (1.5g spices + 2g citric acid\ kg apple pulp) proved to be best in terms of sensory score and T_5 (1.5g spices +2.5g citric acid \ kg apple pulp) of value added apple butter at room temperature. All of the sensory parameters decline slightly during storage but remain in acceptable region even after 90 days of storage.

References

Aggarwal P., Michael M. (2014). Effect of replacing sucrose with fructose on the physico-chemical sensory characteristics of kinnow candy,Czech, *J. Food Sci.*, **32**: 158–163.

Ali Muhammad, Yasser Durrani, AlamZeb, Muhammad Ayub and JavidUllah (2008). Development of diet jam from apple grown in swat (NWFP). *Sarhad J. Agric. Vol.24*,215-218.

Anjali, M., Ranote, P.S. and Bawa, A.S. (2005). Processing of kandi lemon (Galgal) peel waste for candy making. *Indian Food Packer*, **59**(1): 67-74.

AOAC (1970). Official Methods of Analysis. 12th eds. Association of Agricultural Chemists. Washington, DC. USA.

Bracket (1990). Changes in the micro-flora of packaged fresh bell peppers. *J. Food Prot*. **11**(53): 255-257.

Chadha, K.L. (1992). Emerging trends in temperate fruit production in India (Chadha, K.L.,Uppal, D.K. R.N. Awasthi, R.P. and Andnda, S. A. eds) NHB Technological Communication, 1:19.

Ehsan ELahi Bajwa, Naeem ZafrPawaz, Anjum Javed&NazirAhmed.(2003).Development ,standardization and storage studies on grape fruit Apple marmalade . PAK,J:*Food SCI.*.,13(3-4):11-15.

Harrigan WF (1998). Laboratory Methods in Food Microbiology. Seconded.Academic, Sandi ago, CA.

Hiremath, J.B. and Rokhade , A.K. (2012). Preparation of Sapota Candy .*International Journal of Food, Agriculture and Veterinary Sciences*, ISSN: 2277-209X, Vol. 2 (1) January-April.

IftikharShakir, Yasser Durrani, ImtiazHussainm, IhsanMaboodQazi and AlamZeb(.2007): Physicochemical Analysis of Apple and Pear Mixed Fruit Jam Prepared from Varieties Grown in Azad Jammu and Kashir. *Internet Journal of Food Safety*, Vol.9, p. 22-24.

Jawaheer, B.; Goburdhun, D.and Ruggoo, G(**2003**). Effect of processing and storage of guava into jam and juice on the ascorbic acid content. *Plants Foods for Human Nutrition*, Dordrecht, **58** (3): 1-12.

Larmond, E.(1987). Laboratory methods for sensory evaluation of Foods, Depttof Agri Canada Pub. No. 1637/E.

Maul F, Sergeant SA, Baldwin EA, Huber MO (2000). Tomato flavor and aroma quality as affected by storage temperature. J. Food Sci. 65: 1229-1237.

National Horticultural Board data bases (2001-02) and (2006-07).

Rangana,S.(1991).Handbook of Analysis and Quality control for Fruits and Vegetables Products. Tata Mc-Graw Hill Publishing Company Limited, New Delhi, India.

Sarolia, DK, Mukherjee,S.(2002). Comparative efficiency of different preservation methods in keeping quality of lime (*Citrus aurantifolia*) swingle juice during storage. Haryana J HortSci 31: 185-188.

Singh, Rita, Kapoor, A.C. and Gupta, O.P. (2006). The effect of cultivars, seasons and storage on the nutritive value and keeping quality of Apple butter. Indian Food Packer, 71-77.

Sogi, D.S. and Singh, S. (2001) Studies on bitterness development in kinnow juice, ready-to-serve beverage, squash, jam and candy, *J. of Food Sci*. and tech. 38:433-438.

Somogyi M (1945). A new reagent for the determination of sugars. J.Biol. Chem. 160: 61 68.

Srivastava, R.P. (1992). Preservation of Fruit and Vegetable products Bishen Singh Mahendea Pal Singh, New Connauaught Place ,Dehra Dun.

Steel RGD, Torrie JH, Dickey, D.(1997). Principles and Procedures of Statistics. A Biometrical Approach. (3rd Edition). McGraw Hill Book Co, New York, USA

Steel RGD, Torrie JH, Dickey, D. (1997). Principles and Procedures of Statistics.A Biometrical Approach. (3rd Edition). McGraw Hill Book Co, New York, USA.

Wilcox, A.M.N. (1962). *Handbuch der pflanzenziichtung 6, Berlin* pp. 637-45.

Yawin, R.S .and Marsh ,S .(1999). Inspection of finishing product .P. reduction year book food nutrition .(5):17-19.

Z. K. H Gomez and A. A Gomez.(1984).*Statistical procedures for Agricultural Research, 2nd edn.* (John Wiley and sons, New York..

Table 1: Effect of treatments on physiochemical properties of apple butter.

	acidity (%)					TSS (° Brix)					ascorbic acid (mg. /100g)					pH				
	Days after storage					Days after storage					Days after storage					Days after storage				
	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean
T_0	0.70	0.70	0.64	0.61	0.66	63.05	69.55	67.05	62.50	65.54	6.64	5.74	4.01	3.41	4.95	3.60	3.57	5.05	5.50	4.43
T_1	0.57	0.58	0.54	0.50	0.55	65.50	69.90	67.06	63.05	66.38	6.65	5.90	5.00	4.33	5.47	3.23	3.12	4.93	5.50	4.20
T_2	0.59	0.67	0.70	0.73	0.67	66.70	70.35	75.00	78.05	72.53	7.05	6.00	5.13	4.69	5.72	3.40	3.30	3.26	3.23	3.30
T_3	0.67	0.69	0.73	0.75	0.71	66.75	70.40	74.95	78.46	72.64	7.13	6.00	5.13	4.73	5.75	3.28	3.19	3.14	3.11	3.18
T_4	0.69	0.71	0.78	0.80	0.75	66.80	71.15	74.95	78.48	72.85	7.15	6.22	5.14	4.83	5.84	3.55	3.45	3.38	3.31	3.42
T_5	0.70	0.73	0.79	0.82	0.76	68.05	73.40	75.05	80.15	74.16	7.30	6.70	5.18	4.98	6.04	3.87	3.81	3.76	3.71	3.79
T_6	0.73	0.75	0.80	0.83	0.78	70.55	75.15	77.95	80.85	76.13	7.31	6.93	5.20	5.00	6.11	3.13	3.06	3.01	2.98	3.05
T_7	0.80	0.81	0.84	0.88	0.83	67.90	72.00	74.90	78.30	73.28	7.53	7.00	6.20	5.40	6.53	3.53	3.43	3.38	3.34	3.42
T_8	0.82	0.85	0.86	0.89	0.86	67.82	72.07	74.65	79.00	73.39	7.81	7.01	6.22	5.75	6.70	3.65	3.58	3.53	3.47	3.56
T_9	0.84	0.86	0.87	0.90	0.87	69.35	74.10	75.91	80.45	74.95	8.00	7.15	6.35	5.78	6.82	3.15	3.09	3.04	2.99	3.07
F- test	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CV	0.357	0.048	0.221	0.277	0.047	0.351	0.660	0.685	0.701	0.779	0.605	0.755	1.198	1.394	1.046	0.281	0.199	0.264	0.747	0.904
S. Em. (±)	0.071	0.026	0.058	0.065	0.027	0.687	0.974	1.005	1.032	1.060	0.296	0.312	0.358	0.369	0.354	0.139	0.116	0.139	0.236	0.253
C.D.at 5%	0.152	0.056	0.123	0.139	0.057	1.464	2.074	2.140	2.198	2.259	0.631	0.666	0.763	0.787	0.754	0.296	0.246	0.295	0.502	0.539

Table 2: Effect of treatments on organoleptic properties of apple butter

	Colour					Texture/ Body					Flavour/ Taste					Overall acceptability				
	Days after storage					Days after storage					Days after storage					Days after storage				
	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean
T_0	4.67	3.80	0.00	0.00	2.12	4.92	2.70	0.00	0.00	1.91	5.25	3.20	0.00	0.00	2.11	5.08	3.18	0.00	0.00	2.07
T_1	5.83	4.00	0.00	0.00	2.46	5.63	3.40	0.00	0.00	2.26	5.25	4.10	0.00	0.00	2.34	5.48	3.74	0.00	0.00	2.31
T_2	5.83	6.20	5.00	6.30	5.83	6.67	6.00	4.30	6.20	5.79	6.33	6.40	5.00	6.30	6.01	6.25	6.14	4.48	6.28	5.79
T_3	6.83	6.26	6.30	6.33	6.43	7.00	6.20	4.80	6.66	6.17	6.67	6.80	5.20	6.58	6.31	6.95	6.41	5.38	6.43	6.29
T_4	7.50	7.20	7.80	7.55	7.51	7.33	7.20	7.30	7.65	7.37	7.42	7.30	7.40	7.65	7.44	7.37	7.26	7.42	7.69	7.44
T_5	6.75	6.45	7.40	7.40	7.00	7.25	6.50	6.40	7.50	6.91	7.41	7.00	7.20	7.50	7.28	7.17	6.56	6.51	7.64	6.97
T_6	6.67	6.40	6.20	6.66	6.48	6.83	6.30	5.70	7.00	6.46	6.75	6.40	6.40	6.75	6.58	6.88	6.45	6.28	6.78	6.60
T_7	6.59	6.40	6.30	6.50	6.45	7.12	5.80	5.60	6.25	6.19	6.67	7.20	5.90	6.50	6.57	6.82	6.38	5.76	6.40	6.34
T_8	6.75	5.40	7.30	6.17	6.41	5.92	6.10	5.10	6.25	5.84	6.83	6.65	6.10	6.33	6.48	6.43	6.29	5.82	6.35	6.22
T_9	6.19	6.30	6.75	6.13	6.34	5.58	5.90	5.40	6.33	5.80	6.16	6.00	5.20	6.08	5.86	5.89	5.88	5.34	6.21	5.83
F- test	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CV	0.384	0.200	0.099	0.047	0.127	0.752	0.250	0.037	1.701	0.759	0.485	0.880	0.371	0.433	0.641	1.373	1.543	1.233	1.525	2.144
S.Em. (±)	0.221	0.153	0.102	0.070	0.120	0.311	0.167	0.057	0.428	0.288	0.251	0.328	0.189	0.216	0.270	0.420	0.424	0.340	0.405	0.489
C.D. at 5%	0.471	0.326	0.218	0.150	0.257	0.662	0.357	0.122	0.912	0.614	0.534	0.698	0.404	0.459	0.576	0.895	0.903	0.725	0.863	1.042

Table 3. Effect different treatments and their interaction on **microbial count (**fungi x10-2cfu/g) of Apple butter during storage.

Treatments	0 days			30 days			60 days			90 days		
	First Yr	Second Yr	Average	First Yr	Second Yr	Average	First Yr	Second Yr	Average	First Yr	Second Yr	Average
T_0	0.00	01.00	0.50	02.00	02.00	02.00	07.00	07.00	07.00	10.00	11.00	10.50
T_1	00.00	00.00	01.00	01.00	01.00	01.00	05.00	05.00	05.00	08.00	09.00	08.50
T_2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T_9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00