Quality assessment of mixed pickle (carrot, pea and ginger) fermented by Lactic Acid Bacteria

Abstract:

"Studies on preparation and quality evaluation of mixed pickle of carrot, pea and ginger" was made with seven treatments and three replications with the equal proportion of carrot, pea and ginger (500gm each), Salt 10% and lakadong turmeric powder of 10 gm for all treatments with the objective to access the physico-chemico characteristics of fresh vegetables as well as stored mixed pickle at normal room temperature. The biochemical and sensory changes were analysed at monthly interval of initial day, 30 days and 60 days. During storage the TSS, total sugar, acidity, ascorbic acid, β-carotene acid content decreased gradually. The prepared mixed pickle was judged by the 15 panellists during the organoleptic test where using Five-Point hedonic scale in which treatment T_7 (2% lemon juice + 2% acetic acid + mustard oil (250ml) + red chilli (20g) recorded the maximum value with 4.53 followed by treatment T_5 (2% acetic acid + red chilli powder (20g) + mustard oil (250ml) with 4.32 up to 60 days of storage. Overall assessment of quality revealed that with respect to conjugal study of all the parameters of total soluble solid, total sugar, acidity and ascorbic acid and β- carotene, the treatment T_5 prepared with (2% acetic acid + red chilli powder (20g) + mustard oil (250ml) proved considerably superior over other treatments with the maximum acceptability.

Keywords: Carrot, pea, ginger, storage, mixed pickle, analysed, ambient temperature

Introduction

India is the world's second largest producer of vegetables; they share 16% in total world production. Vegetables are highly nutritious and perishable foods that have very short shelf lives. The total production of vegetables is over 45 million tones and 85 million tons respectively. In India, Vegetables are grown on an area of 9083 thousand hectares with a production of 156445 thousand tonnes. The losses are estimated to the extent of 30-40% due to the lack of proper harvesting, processing and storage facilities, which are valued at Rs. 230 billion. According to National Horticulture Board, 2019-20 the 1st estimation cost in area and production of carrot, pea and ginger was 112 ha, 564 ha, 168 ha (thousand) and the production was 2042 MT, 5694 MT, 1805 MT (thousand) respectively and the 2nd estimation cost of 2019-20 was 104 ha, 563 ha, 172 ha (thousand) in area and 1838 MT, 5703 MT, 1844 MT (thousand) respectively.

Carrot, Pea and ginger are important to their inexpensiveness and valuable nutrient contents. Since these vegetables are perishable in nature, there is necessity of processing and preservation for future use and overcome the national loss. Fortunately, most perishable foods can be made stable and acceptable by the judicious application of present-day technology. There are several methods for processing of these vegetables. Among them pickling is one of the best methods for processing of these vegetables and it can be used around the year. When any food (fruits, vegetables, fish or meat) is preserved by natural preservatives like salt, organic vinegar and edible oil along with lactic acid fermentation, then the processed food is called pickles. Pickles are good appetizers and add to the palatability of a meal. Pickling is a traditional process that preserves vegetables and fruits through anaerobic fermentation or acidification with vinegar (Hassan and Sarfraz, 2018), resulting in fermented products being regularly consumed in most societies throughout the world. Pickling is the result of fermentation by "Lactic acid bacteria". Pickles are fermented mainly by lactic acid bacteria which are considered to lower serum cholesterol level and help in preventing tumours by stimulating immune response thus acting as probiotic in human body (Monica *et al.*, 2016)

The objective of this research are to access the entitled the physico-chemical characteristics of fresh vegetables of carrot, pea and ginger, to standardize the recipe of mixed pickle, to analyse the quality parameters of prepared mixed pickle during storage at normal temperature.

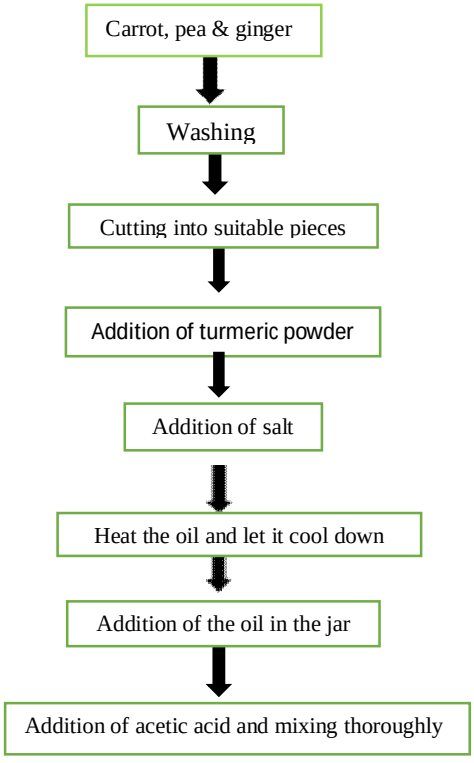
MATERIALS AND METHODS

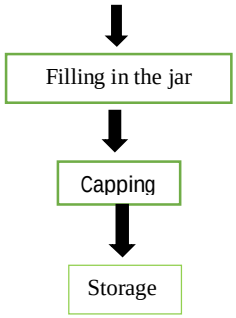
The experiment was carried out in the Laboratory of Horticulture, North-Eastern Hill University, Tura Campus, Chasingre, Tura, Meghalaya during the year 2020-2022. The raw materials of carrot, pea and ginger were procured from Tura market. The lactic acid bacteria are collected from laboratory of Horticulture, NEHU, Tura Campus Meghalaya. Carrot and ginger are peeled off, cut into the suitable pieces and for pea it was removed the peel and collect the fresh green pea. Amount required for preparation of sample were calculated as per the number of treatments, replication and proportions of other ingredients. The ingredients were prepared according to the treatment which was adjusted by adding lemon juice and acetic acid respectively. 500gm of samples were filled into containers with capacity of 750 gm and 250 ml of mustard oil, 10% salt, 10gm turmeric powder were added in each treatment. Mixed Pickle was prepared by using different recipes were analysed at 0, 30 & 60 days for their physico-chemical composition i.e. TSS (^{O}Brix), Acidity (%) by (AOAC (1984)), Ascorbic acid (mg/100g) by (Ranganna, 2004), Total sugar (%) by (Lane and Eynon, 1923), β carotene (I.U) by (Ranganna, 2004) & organoleptic quality with 5.0 Hedonic scale at monthly interval by (Amerine *et al.*, 1965). The results were analysed statistically by completely randomized design. The various recipes followed for the preparation of mixed pickle were outlined in Table-1. The process of pickle making is depicted in Flow chart 1.

Table 1: Recipe for the preparation of mixed pickle

Treatments	**Proportion of ingredient for carrot, pea and ginger (500gm each- 1.5 kg)**
T_1	Control (base) salt + mustard oil (250ml)
T_2	2% lemon juice + mustard oil (250ml)
T_3	2% lemon juice + Red chilli powder(20g) +mustard oil (250ml)
T_4	2% acetic acid + mustard oil (250 ml)
T_5	2% acetic acid + red chilli powder (20g) + mustard oil (250ml)
T_6	2% lemon juice + 2% acetic acid + mustard oil (250ml)
T_7	2% lemon juice + 2% acetic acid + mustard oil (250ml) + red chilli (20g)
Salt 10% + turmeric powder for all treatments (10g)	

Flow chart 1: Technique used for preparation of mixed pickle





RESULTS

Physio- chemical characteristics of Fresh vegetables of Carrot, Pea and Ginger

The colour was seen vivid orange 28B, green 140B and pale yellow, 8D by RHS chart and as well as the visual observation in carrot, pea and ginger respectively. Simultaneously it was found the shelling percent in pea 48% in a semi mature condition. The nutritional value of fresh vegetables of Carrot, Pea and Ginger are presented in Table 2. The results of nutritive value in a respect of TSS was 9.33 °Brix, 7.33°Brix, 6.80°Brix, Total sugar 4.26%, 2.43 %, 1.77%, Reducing sugar (1.35%), (1.09%), (1.50%), non-reducing sugar (2.76%), (1.27%), (0.26%) titratable acidity (0.12%), (0.12%), (0.12%), ascorbic acid (4.32mg/100g), (12.96mg/100g), (5.40mg/100g) in carrot, pea and ginger respectively whereas it was also analysed the β carotene (2312.451 IU) only in carrot. A similar line of work made by Sharma and Sharma (2020) showed that orange carrot contained 7.50 °Brix total soluble solid, 4.25 %, total sugar, 2.04 % reducing sugar, 0.09 %, acidity, 2.09% non-reducing sugar. 12.30 mg/100g carotenoids. Kaur *et al*. (1976) have reported 1.67–3.35% reducing sugars, 1.02–1.18% non-reducing sugars and 2.71–4.53% total sugars in 6 cultivars of carrot. Sultana *et al.* (2014) reported that the chemical composition of fresh carrot contained 88.2% moisture content, 1.16% protein, 0.52% ash, 0.135% acidity and 8.56 mg/100 g vitamin C respectively. Molla *et al*. (2008) reported the chemical composition of fresh carrot contained 3.0 mg/100g Vitamin-C, 3000.0 IU/mg Pro-Vitamin-A. Hashem *et al*. (2014) reported the chemical composition of fresh carrot was that the mineral content varied from 0.01 to 11.5 mg/100g, Potassium mg/100g, magnesium 10.66 mg/100g, calcium 8.2 mg/100g and sodium 3.17 mg/100g. A similar line of work done by Shah *et al.* (2021) reported the effect of predrying treatments on the quality attributes of green peas (*Pisum sativum* L.). In this study, the moisture content (73%), TSS (15°B), chlorophyll content (28mg/100g) and ascorbic acid (54mg/100g) were recorded in green pea

Sensory evaluation

Periodical panel tests of mixed pickle were conducted at a monthly interval of initial day, 30 days and 60 days by 15 semi trained panellists respectively and are presented in Table 3. Consumer acceptability of the mixed pickle was significant ($P \leq 0.01$) among the treatment combinations up to 60 days of storage at normal temperature. The acceptability on the basis of overall acceptance 5.0 Point rating scored ranged between 2.73 to 4.38, 2.65 to 4.47 and 2.76 to 4.59 respectively during storage period at ambient condition. Whereas the treatments T_7 (4.38), (4.47) and (4.59) showed highest acceptability scored on par with T_5 (4.15), (4.24) and (4.32) at initial day, at 30 days and after 60 days of storage respectively while. The other treatments were also found good but did not compete with T_7 among the aroma, texture and taste by the panellists, it might be due to effect the treatments combination. The results of sensory evaluation of mixed pickle was in agreement with Uthpala *et al.* (2018) analysed the sensory quality and physicochemical evaluation of two brine pickled cucumber (*Cucumis sativus* L.) varieties its sensory attributes and physicochemical changes within 6 month of brine fermentation. Rudrawar *et al.* (2016) worked on development and standardization of jackfruit pickle and study of sensory analysis. Devi (2018) reported assessment of sensory and storage life for determining the quality of bitter brinjal pickle.

Total soluble solids (T.S.S)

Total soluble solids (T.S.S.) of the mixed pickle showed gradual decline in TSS content during storage period and data are shown in Table 4. A significant difference ($P \leq 0.01$) amongst the treatments was noticed in TSS content of initial day,30 days and 60 days. At the time of preparation, mixed pickle varied in T_2 was having 16.93°Brix to 16.20°Brix at 30 days of storage which gradually decreased at 60 days of storage to 15.77°Brix. The amount of TSS was found retained maximum in T_2 (6.85%) from the initial day to 60 days of storage. The decrease of TSS was significantly affected by salt concentration. The findings of Rajendra Kumar (2021) in

aonla pickle reported gradual decreased in TSS content during storage support present findings the contention that total soluble solids months after storage of start declining.

Total Sugar

The total sugar was found decreasing with increasing storage day. The data of Total sugar content of mixed pickle is presented in Table 4 and showed a significant difference ($P \leq 0.01$) from the initial day to 60 days of storage among the seven treatments at normal temperature. During initial day the total sugar was found the highest in T_5 with (3.26%), (2.87%) at 30 days and (2.80%) at 60 days of storage over the other treatments. The amount of total sugar was retained maximum in T_5 (14.11%) from the initial day to 60 days of storage. The decreasing of total sugar content with storage might be due to conversion of sugar into invert sugar as well as salt concentration.

Acidity

The value of acidity decreased along with storage and value was statistically significant ($P \leq 0.01$) within the treatments. At initial day the amount of acidity was decreased least in T_4 with (2.56%) to (1.07%) after 60 days of storage and value depicted from Table 4. The acidity was a main course of ingredients for the mixed pickle to enhance the palatability as well as protect from foreign microbes. So, it was retained the maximum amount of acid in T_4 with (58.20%) at 60 days of storage. The value of acidity decreased along with storage which might be due to co-polymerization of organic acids with Sugar & Amino acid. The worked done by Rajendra Kumar (2021) in aonla pickle. A similar worked done by Dhiman *et al. (*2016) revealed that there was a decrease in % titratable acidity of osmotically dehydrated wild pear halves during the storage period of six months.

Ascorbic acid:

The Ascorbic acid content of mixed pickle decreasing with increasing storage period while the Ascorbic acid content of mixed pickle showed significantly difference ($P \leq 0.01$) within the treatments at initial and 30 days' storage whereas the data showed non-significant in 60 days of storage at normal temperature shown in Table 4. At initial day of storage, the maximum value was recorded in T_4 with (10.90 mg/100g), at 30 day of storage the maximum value in T_4 with (10.12 mg/100g) and the minimum loss was observed in T_4 (7.16%) after 60 days of storage. This loss of ascorbic acid content might be due to the leaching loss by the osmotic action of added salt & sugar and also its conversions into dehydro ascorbic acid by oxidation, as saline solution enhances rate of oxidation of ascorbic acid. A similar worked done by Sultana *et al.* (2014) observed that the vitamin C content was drastically reduced after complete fermentation.

β Carotene

The β Carotene content of mixed pickle when stored up to 60 days at normal temperature was found significantly difference ($P \leq 0.01$) among the treatments. The data pertaining in Table 4 and showed the initial day of β Carotene was recorded the maximum in T_6 (2173.88 I. U) whereas after 30 days storage the highest value was observed in T_1 (1965.94 I. U). Simultaneously it was also observed after 60 days of storage, the maximum value was found in T_1 (1899.46 I.U) followed by T_7 (1846.63 I.U). The decreased of pro-vitamin-A might be due to increase of temperature during storage. A similar study was made by Rygg (1949) mentioned that increased storage temperature over the range 2-24^{O}C had little effect on changes in carotene content.

Conclusion

This study gives a good prospect on processing of mixed pickle of carrot, pea and ginger. Mixed pickle is highly perishable. So, proper preservatives like salt, mustard oil, acetic acid and vinegar should be used in proper concentration to extend the shelf life of the pickle. From this study, it was found that fungal growth was a great problem of pickle. If we add proper concentration of preservatives, the fungal growth becomes very low. Based on the biochemical activity, recorded during the 60 days of storage of mixed pickle at normal temperature, it is indicating that TSS, Total sugar, Acidity, β carotene decreased gradually during storage in all the treatments. The panelists also tested the product and gave the score for colour, flavour, texture and overall acceptability and was found that T_7 proved considerably superior over other treatments with maximum acceptable. Formulation of this pickle can be developed at household or commercial level to generate income and occupy a space in the market.

Sl. No.	Chemical parameters	carrot	pea	ginger

1.	TSS (° Brix)	9.33	7.33	6.80
2.	Total sugar (%)	4.26	2.43	1.77
3.	Reducing sugar (%)	1.35	1.09	1.50
4.	Non reducing sugar (%)	2.76	1.27	0.26
5.	Acidity (%)	0.12	0.12	0.12
6.	Ascorbic acid (mg/100g)	4.32	12.96	5.40
7.	β carotene(I.U)	2312.451		

Table 2: Chemical Characteristics of fresh vegetables

Treatments	**Organoleptic Score (5.0 Hedonic Scale)**		
Salt 10% + turmeric powder for all treatments (10g)	0 days	30 days	60 days
T_1(Control (base)+ mustard oil (250 ml)	2.73	2.65	2.76
T_2(2% lemon juice + mustard oil (250ml)	3.42	3.24	3.22
T_3(2% lemon juice + Red chilli powder(20g) +mustard oil (250ml)	3.31	3.27	3.27
T_4(2% acetic acid + mustard oil (250 ml)	4.01	4.18	4.22
T5(2% acetic acid + red chilli powder (20g) + mustard oil (250ml)	4.15	4.24	4.32
T_6(2% lemon juice + 2% acetic acid + mustard oil (250ml)	3.24	3.06	3.21
T7(2% lemon juice + 2% acetic acid + mustard oil (250ml) + red chilli (20g)	4.38	4.47	4.59
Mean	3.61	3.59	3.66
SE(d)	**0.27**	**0.33**	**0.29**
C.D.(.01)	**0.80**	**1.00**	**0.87**
C.V.(%)	**11.88**	**14.85**	**12.63**

Table 3: Sensory evaluation score of mixed pickle

Treatments	**TSS(°Brix)**			**Total sugar(%)**			**Acidity(%)**			**Ascorbic acid (mg/100g)**			**β carotene (I.U)**		
Salt 10% + turmeric powder for all treatments (10g)	**0 day**	**30 days**	**60 days**	**0 day**	**30 days**	**60 days**	**0 day**	**30 days**	**60 days**	**0 day**	**30 days**	**60 days**	**0 day**	**30 days**	**60 days**
T_1(Control (base)+ mustard oil (250 ml)	16.07	15.9	14.76	2.97	2.83	2.42	0.81	0.68	0.38	6.55	6.16	6.00	2061.39	1965.94	1899.46
T_2(2% lemon juice + mustard oil (250ml)	16.93	16.2	15.77	2.96	2.82	2.21	1.37	0.68	0.55	7.64	6.60	5.50	1887.53	1752.83	1521.07
T_3(2% lemon juice + Red chilli powder(20g) +mustard oil (250ml)	16.00	15.5	15.41	2.19	2.07	1.73	1.28	0.55	0.55	9.10	8.36	7.50	1504.03	1357.45	1190.41
T_4(2% acetic acid + mustard oil (250 ml)	15.33	15.2	14.80	2.87	2.62	2.53	2.56	1.62	1.07	10.92	10.12	9.00	2027.21	1815.94	1359.15
T5(2% acetic acid + red chilli powder (20g) + mustard oil (250ml)	8.33	8.1	7.60	3.26	2.87	2.80	2.48	1.41	1.02	9.46	8.80	8.00	2141.48	1918.21	1780.15
T_6(2% lemon juice + 2% acetic acid + mustard oil (250ml)	7.47	7.2	7.00	3.05	2.27	1.94	2.13	1.32	0.94	8.74	7.92	6.00	2173.88	1497.21	1171.67
T7(2% lemon juice + 2% acetic acid + mustard oil (250ml) + red chilli (20g)	7.33	7.0	6.73	2.56	2.42	2.36	1.58	1.37	0.85	8.01	7.92	7.00	2051.16	1940.37	1846.63
Mean	**12.50**	**12.2**	**11.72**	**2.84**	**2.56**	**2.28**	**1.74**	**1.09**	**0.77**	**8.63**	**7.98**	**7.00**	**1978.11**	**1749.72**	**1538.37**
SE(d)	**0.93**	**0.19**	**0.19**	**0.26**	**0.21**	**0.19**	**0.14**	**0.10**	**0.07**	**0.67**	**0.74**	**NA**	**64.36**	**35.27**	**47.63**
C.D.(.01)	**2.76**	**0.55**	**0.55**	**0.77**	**0.65**	**0.56**	**0.44**	**0.31**	**0.22**	**2.00**	**1.61**		**139.39**	**76.39**	**103.16**
C.V.(%)	**9.09**	**1.87**	**1.96**	**11.21**	**10.45**	**10.39**	**10.31**	**11.87**	**11.89**	**9.56**	**11.41**		**3.99**	**2.47**	**14.51**

Table 4: Changes in nutritive value of mixed pickle during storage period at normal temperature

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