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Research Article

STORAGE STUDIES OF READY-TO-EAT STUFFED VEGETABLES DEVELOPED USING COMBINATION PRESERVATION TECHNOLOGY

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ABSTRACT

The aim of the present study was to establish shelf life for vegetable based Ready-to-Eat stuffed products which were developed using combination preservation technologies such as blanching, drying, addition of preservatives, cooking in oil and in-pack pasteurization. In the present study, three vegetables - bitter gourd, brinjal and potato were used for the development of Ready-to-Eat stuffed vegetables and were stored at 25 ± 2°C and were analyzed periodically for storage stability characteristics viz., Functional, nutritional, quality and sensory evaluations. Functional parameters, nutritional and sensory parameters got decreased, quality parameters such as pH, water activity, peroxide value, free fatty acid and TBA were increased and titrable acidity was decreased. The Ready-to-Eat stuffed vegetable products packed in four layered co-extruded film pack were found stable and acceptable for 30 days at ambient temperature condition (25 ± 2°C).

Keywords: Ready-to-eat stuffed vegetables, storage stability, sensory parameters, microbiological parameters, bitter gourd, brinjal, potato

PRACTICAL APPLICATION

According to the consumer's demands for healthier Ready-to-Eat (RTE) products, three RTE stuffed vegetables were developed. Since vegetables are very perishable, the research is valuable in terms of preserving the vegetable products from spoilage by using various combination preservation technologies such as blanching, drying, addition of preservatives, cooking in oil and in-pack pasteurization. Giving a deeper insight into their functional, nutritional, quality and sensory parameters. This paper could contribute to food industry in development of RTE products with desirable and attractive properties.

INTRODUCTION

Vegetables are excellent sources of vitamins [A, B complex (B1, B6, B9) and E], dietary fibre, minerals, and phytochemicals [1,2]. Consumption of vegetables in our daily diet results with over-all good health impact, reduction in gastrointestinal problems, improvement in vision and also playing an major role to reduce danger for various systems of cardiovascular problems, cancer, diabetes, stroke, gastric ulcer and other long-lasting disorders [3,4]. Lower risk of cardio-vascular diseases in humans strongly associated with high consumption of vegetable diet [5].

Bitter gourd (Memordica charantia) belongs to family Cucurbitaceae. It is a most common vegetable cultivated across India during warm season. Native to India or China, the fast-growing vine is grown throughout Asia and is becoming popular worldwide. Depending on location, bitter gourd is also well known as bitter melon, Balsam pear. The immature fruits and tender vine tips are used in a various culinary preparations. The vegetable is a good source of Vitamin C and fair source of protein, minerals, while poor source of sugar [6]. Some of the work is carried out on preservation of bitter gourd by different methods such as steeping preservation, processing of bitter gourd into rings [7], sun drying and dehydration of bitter gourd [8], hot air drying of bitter gourd slices [9] etc. Bitter gourd has excellent medicinal virtue. The medicinal value of bitter gourd in the treatment of infectious diseases and diabetes is attracting

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the attention of researchers worldwide. Bitter gourd is stimulant, stomachie, laxative, blood purifier and anti-diabetic [10].

Eggplant (S. melongena) usually known as brinjal in South Asia (especially Pakistan, India, and Bangladesh), aubergine in Europe, melongene in West Indies, Guinea squash in America and patlican in Turkey. It belongs to a family Solanacea with a bushy foliage with an average height of about 60 to 95 cm. Eggplant is a warm season plant. The fruit is very nutritious and uses for medicinal purpose [11]. Eggplant is ranked amongst the most top ten vegetables that provide the healthiest food with low calories and also contain high phenolic contents that are helpful in radical absorbing capacity [12,13]. Eggplant is a host of various vitamins, minerals, iron, calcium, potassium, magnesium, and phytochemicals that contain phenolic components (caffeine and chlorogenic acid), flavonoids, mainly nasunin. Nasrin or delphinidin- 3-(coumaroyl-rutinoside)- 5-glucoside is key phytochemical in brinjal that is present in peel of eggplant [14].

Potatoes (Solanum tuberosum L) belong to family Solanaceae originated in the Andean mountain region of South America. There are about five thousand potato varieties worldwide [15]. As per Food and Agriculture Organization Statistical Databases of United Nation (FAOSTAT) potatoes account for only about 2% of the world's dietary energy supply [16]. Potatoes are rich in various essential nutrients that include carbohydrates, protein, vitamin C, vitamin B6, magnesium, potassium, fibre. The nutritive value of potatoes along with its taste and ease of cooking has made it the most popular vegetable and snack in the world. People in under developed countries, who are unable to afford high-energy diets such as meat and milk products, use potatoes as their prime source of nutrient energy [17].

Ready-to-Eat food is food that is offered for sale without additional cooking or preparation, which is packaged on the premises where they are being sold and are ready for consumption. Canned foods, convenient foods, fast foods, frozen foods, instant food products, dried foods, preserved foods, etc. all come under Ready-to-Eat foods. Factors influencing the consumer choice of RTE foods are flavor, texture, taste, appearance, advertising, a reduction in traditional cooking, fragmentation of family. Other factors influencing Ready-to-Eat food demand are rising income level, influence of western countries, more global trade, travelling, convenience in preparation due to lack of time and cost effectiveness [18].

In the present study, storage stability studies were conducted to already developed three ready-to-eat (RTE) stuffed vegetable products viz., bitter gourd stuffed RTE product, brinjal stuffed RTE product and potato stuffed RTE product using combination preservation technologies such as blanching, drying, addition of preservatives, cooking in oil and in-pack pasteurization. These developed products were evaluated for nutritional, functional, quality sensory and microbial parameters. Argyropoulos et al., (2011) [19], reported that drying is a majorly used preservation method to prevent the different types of spoilage including enzymatic or non-enzymatic browning and microbial growth by reducing the moisture content to a safe level of storage. Blanching is normally carried out to inhibit enzyme activity and to kill microorganisms. It also removes the air from the fruits and vegetables to prevent off-colour and flavour changes during drying [20]. In the present study hot water blanching was used as initial step of processing the vegetables such as bitter gourd and potato. Preservatives will help to retain the keeping quality of foods for a longer period of time, decrease the microbial activity, improve the sensory and nutritional characteristics [21].

Presently ready-to-eat foods have been increasingly gaining popularity among masses. Therefore, the present study aimed at the stability studies of developed ready-to-eat stuffed vegetable using combination preservation technology and at ambient temperature (25±2°C) and to evaluate its nutritional, functional, quality, sensory and microbial parameters.

MATERIALS AND METHODS

Materials

Good quality raw materials, Bitter gourd (Momordica charantia) - dark green variety, Brinjal (Solanum melongena) - purple variety, Potato (Solanum tuberosum), spice mixtures (MTR brand), amchur powder, chili powder, cumin powder, garam masala powder, turmeric powder; onion powder (MDH brand), garlic powder (MDH brand), fennel seeds, salt and rice bran oil were procured from the Mysore local market. Four layered co-extruded film pack was used for packing the developed products. The packaging material was composed of poly ethylene teraphthlate (PET) - 12µ, Aluminium foil – 9µ, Nylon - 15 µ, and Cast polypropylene (CPP) - 70 µ and the length of the pouches were 18cm. All the chemicals, standards, organic solvents and acids used were of analytical grade and procured from Central drug house Pvt Ltd, New Delhi, Ranboxy fine chemicals, New Delhi, RFCL Ltd, New Delhi, Qualigens Fine Chemicals, Mumbai, Nice chemicals Pvt Ltd, Kerala, Hi media laboratories Pvt Ltd, Mumbai, SDFCL fine chemicals, Mumbai and Sigma Pvt Ltd, Mumbai.

Three RTE stuffed vegetable products viz., bitter gourd stuffed RTE product, brinjal stuffed RTE product and potato stuffed RTE product were developed using combination preservation technologies such as blanching, drying, addition of preservatives, cooking in oil and in-pack pasteurization and were estimated for the shelf stability.

METHODS

Storage analysis of Stuffed vegetable samples

Storage studies were conducted for stuffed bitter gourd, brinjal and potato stored RT (25 ± 2°C) for functional–total phenols [22] and total flavonoids [23]; nutritional–vitamin C [24]; and quality parameters – pH (digital pH-meter: pH tutor, P\N 54 002606, Cyber scan, India.), Water activity is measured by Aqualab 4TE water activity meter, acidity [24], peroxide value, free fatty acid [25], TBA [26]. Microbial analysis was carried out according to [27]. The samples were subjected to the analysis of TPC, Coliforms, Yeast and Moulds.

Sensory Evaluation

Sensory evaluation of the-ready-to eat stuffed vegetable were carried out by 20 semi trained panel members for grading the product in terms of colour, aroma, taste, texture and over all acceptability on a 9-point Hedonic scale, with 9 as excellent in all respects and 1 for unacceptable samples [28].

Statistical analysis

The data was analysed statistically for the mean, standard deviation, Student's t test with MS Office-2007 analysis tool-pack.

RESULTS AND DISCUSSIONS

The studies on shelf life establishment of ready-to-eat stuffed vegetable products developed using combination preservation technologies are discussed below. Shelf life of any product indicates its potential for being stored for a definite period of time without any deteriorating effects on its quality parameters. Storage life indirectly indicates the market life of the product. In the present study, 3 stuffed vegetables viz., bitter gourd, brinjal and potato were processed with multiple preservation technologies and processed in coextruded film pouches by pasteurizing at 90°C for 20 minutes and they were stored at RT (ambient temperature, 25 ± 2°C), and were evaluated periodically for functional, nutritional, quality and sensory parameters. Total phenols (mg/100ml gallic acid equivalents) and total flavonoids (mg of catechin equivalents /100g) were considered as functional parameters, vitamin C (mg/100gm) as nutritional parameter, and pH, water activity, titrable acidity, free fatty acids, peroxide value and TBA value were considered as quality parameters, sensory evaluation for overall acceptability and microbiological studies were studied in the stored samples. The acceptability scores which has helped to establish the shelf life.

FUNCTIONAL PARAMETERS

Total phenols (mg/100ml gallic acid equivalents) and total flavonoids (mg/100ml catechin equivalents) were considered as functional parameters. Changes during the storage period on functional parametes are presented in Table1

Table1: Storage stability study of Stuffed Vegetables on Functional Parameters (n=3)

Samples	**Storage temperature**	**Period in days**	**Total phenols (mg/100ml gallic acid)**	**Total flavonoids(mg/100ml catechin)**
Bitter gourd	25 ± 2°C	0	104.00±0.65	32.00±0.37
		15	94.00±0.50b	21.00±0.22c
		30	88.43±0.69b	19.00±0.94b
Brinjal	25 ± 2°C	0	260.00±0.37	50.97±0.90
		15	239.23±0.69b	28.40±0.73b
		30	225.23±2.02b	19.00±0.43a
Potato	25 ± 2°C	0	72.53±0.40	20.51±0.58
		15	70.57±0.63c	12.00±0.78b
		30	44.00±0.36a	8.00±0.70b

Table 2: Storage stability study of Stuffed Vegetables on Vitamin C (n=3)

Samples	**Storage temperature**	**Period in days**	**Vitamin C (mg/100gm)**
Bitter gourd	25 ± 2°C	0	20.63±0.66
		15	16.80±0.29c
		30	14.80±0.36b
Brinjal	25 ± 2°C	0	14.53±0.57
		15	12.00±0.45d
		30	10.35±0.40b
Potato	25 ± 2°C	0	16.87±0.54
		15	10.80±0.37c
		30	8.90±0.33b

Table 3: Storage stability study of Stuffed Vegetables on Quality Parameters (n=3)

Samples	**Storage temperature**	**Period in days**	**pH conc.**	**Water activity**	**Titrable acidity (%)**	**Peroxide value (MEq O2/gm)**	**Free fatty acid (%/gm)**	**TBA (mg/malonaldehyde/kg)**
Bitter gourd	25 ± 2°C	0	5.20±0.37	0.85±0.05	0.27±0.07	0.17±0.02	0.10±0.017	0.23±0.02
		15	5.83±0.53d	0.85±0.07a	0.26±0.04d	0.29±0.03b	0.15±0.025c	0.62±0.03b
		30	6.47±0.49d	0.86±0.03c	0.18±0.03d	0.37±0.02c	0.22±0.027c	0.96±0.02a
Brinjal	25 ± 2°C	0	6.07±0.68	0.90±0.08	0.26±0.04	0.12±0.017	0.07±0.012	0.20±0.02
		15	6.17±0.25d	0.90±0.12b	0.26±0.04d	0.19±0.018d	0.13±0.014d	0.60±0.03a

		30	6.75± 0.46d	0.92± 0.05 a	0.23± 0.03d	0.24± 0.020 c	0.19± 0.017 c	0.92± 0.02a
Potato	25 ± 2°C	0	5.71± 0.52	0.89± 0.08	0.35± 0.02	0.20± 0.017	0.06± 0.017	0.19± 0.02
		15	5.74± 0.32d	0.90± 0.09b	0.33± 0.03c	0.28± 0.020 c	0.09± 0.020 d	0.53± 0.02a
		30	6.57± 0.57d	0.91± 0.15a	0.23± 0.04c	0.41± 0.040 c	0.14± 0.021 d	0.93± 0.04a

Table 4: Storage stability study of Stuffed Vegetables on instrumented Colour (n=3)

Sample	**Storage period (Days)**	L*	A*	B*
Bitter gourd	0	28.21	5.58	26.6
	15	29.11	7.13	29.9
Brinjal	0	36.09	4.37	24.2
	15	36.61	4.91	29.6
Potato	0	47.79	4.49	31.5
	15	47.16	3.59	28.2

Table 5: Storage stability study of Stuffed Vegetables on Sensory Score (n=20)

Samples	**Storage temperature**	**Period in days**	**Color**	**Aroma**	**Texture**	**Taste**	**Over all acceptability**
Bitter gourd	25 ± 2°C	0	8.3±0.3	8.2±0.38	8.0±0.31	8.3±0.36	8.1±0.49
		15	7.9±0.38a	7.8±0.26b	7.9±0.36c	7.8±0.37c	7.9±0.34b
		30	6.9±0.50c	6.9±0.41c	7.1±0.30a	7.0±0.38a	6.8±0.57a
Brinjal	25 ± 2°C	0	8.0±0.44	8.0±0.52	8.1±0.50	8.0±0.42	8.1±0.41
		15	7.1±0.46a	6.6±0.43b	6.3±0.50a	6.3±0.44d	6.4±0.51d
		30	7.1±0.36c	6.1±0.41a	5.8±0.38a	6.0±0.46d	6.9±0.49b
Potato	25 ± 2°C	0	8.2±0.16	8.0±0.41	8.2±0.38	8.1±0.36	8.2±0.49
		15	7.9±0.37a	8.0±0.39b	7.8±0.44d	7.9±0.54b	7.8±0.46b
		30	7.0±0.40a	6.9±0.40d	7.0±0.26a	6.8±0.49d	6.9±0.26d

Table 6: Microbiological analysis of Stuffed Vegetable Samples

Sample	TPC	Coli forms	Yeasts and moulds
	(CFU/ g)	(CFU/ g)	(CFU/ g)
Bitter gourd	5	Nil	Nil
	X103		
Brinjal	8	Nil	Nil
	X101		
Potato	4	Nil	Nil
	X102		

In the initial total phenols of stuffed bitter groud, brinjal and potato were 104mg, 260mg and 72.53mg per 100gm of sample respectively. Total phenol content decreased from the level of 104mg to 94mg and 88.43 mg per 100gm of the stuffed bittergourd sample in 15 days and 30 days respectively when stored at ambient temperature (25 ± 2°C). It is noteworhty to mention that as shown in Table 1, even in stuffed brinjal and potato products there was reduction in total phenol content. The percentage of reduction of total phenolic contents was higher in stuffed potatoes (39%), followed by bitter gourd (15%) and brinjal (13%) when stored for 30 days at ambient temperature. (Myojin) [29], reported that there was reduction of total phenols and radical scavenging activity from 227 to 202 µmol gallic acid eq./100 g and 431 to 336µmol Trolox eq./100 g fresh weight on 6 months of storage of frozen bittergourd samples respectively. The total phenolic content in bittergourd juice on the first day as reported by (Kaur and Aggarwal) [30], was 60 to 84mg/100g in different chemically and thermally treated sample. Accodring to them both the treatments and storage affected the total phenols non-significantly ($p \leq 0.05$) at the end of 6 months, and there was a decline in the total phenolic content to 28 to 54mg/100gm. (Singh) [31], identified many kinds of phenolic compounds such as Ncaffeoylputrescine, 5-caffeoylquinic acid, and 3-acetyl-5-caffeoylquinic acid from brinjal pulp. (Noda) [32], also reported that nasunin, delphinidin-3-(pcoumaroylrutinoside)-5-glucoside, was a representative anthocyanin in brinjal peel. (Peerzada) [33], also reported that there was decline in total phenolics during storage.

In the initial total flavonoids of stuffed bitter groud, brinjal and potato were were 32mg, 50.97mg and 20.51mg per 100gm of sample respectively. Total flavonoid content decreased significantly from the level of 32mg to 21mg and 19mg per 100gm of the stuffed bittergourd sample in 15 days and 30 days respectively when stored at ambient temperature (25 ± 2°C). It is noteworhty to mention that as shown in Table 1, even in stuffed brinjal and potato products there was significant reduction in total flavonoid content. The percentage of reduction of total flavonoid contents was higher in stuffed brinjal (63%), followed by potatoes (61%) and bitter gourd (41%) when stored for 30 days at ambient temperature (25 ± 2°C).

Nutritional parameters

Vitamin C (mg/100ml) was considered as nutritional parameters. Changes during the storage period on vitamin C content is presented in Table 2.

Vitamin C

Vitamin C was very less stable which reduced significantly more in stuffed potatoes (47%), and bittergourd and brinjal showed 28% and 29% respectively when stored at ambient temperature for 30 days. (Myojin) [29], reported that there was reduction of vitamins from 55 to 41mg/100gm fresh weight on 6 months of storage of frozen bittergourd samples. (Kaur and Aggarwal) [30], also reported that Vitamin C content decreased significantly ($p \leq 0.05$) during the storage. On the day of preparation, Vitamin C content was 25 to 36.65mg/100g in different chemically and thermlly treated samples. The values came out to be lower because of heat treatment and destroyed Vitamin C. At the end of 6 months, the Vitamin C content reduced to 11.97 to 18.21mg/100gm. Vitamin C is light and thermo-sensitive, the concentration of Vitamin C follows first order kinetics and thus storage time affects Vitamin C content. Several workers have reported the stability of this vitamin in potatoes irradiated for sprout inhibition purposes. Irradiation with 0.07 to 1.0 kg, two weeks after harvest, had no effect on vitamin C [34]. In another study, no immediate change in vitamin C content was observed after exposure to 0.1 to 1.0 kg whereas after one week the levels decreased in proportion to the increasing dose [35]. An immediate oxidation of vitamin C was observed following irradiation at 0.1 kg but the difference in content between the irradiated and the non-irradiated tubers disappeared on prolonged storage [36]. In South African potato cultivars no detrimental effect on ascorbic acid was reported after exposure up to 0.15 kg 16 weeks of storage [37]. During the storage period (10°C), total ascorbic acid, ascorbic acid, and dehydroascorbic acid contents were reduced, and the ascorbic acid of the irradiated carrot and kale juice were higher than that of the non-irradiated one at three days storage.

Quality parameters

The results on the changes in quality parameters during storage of stuffed vegetables are given in Table 3.

As shown in Table 3 it was found that there was increase in pH from 5.20 to 6.47 in stuffed bitter gourd, 6.07 to 6.75 in stuffed brinjal and 5.71 to 6.57 in stuffed potato for 30 days of storage period. (Arvanitoyannis) [38] reported that after 90 days of storage of potatoes, the pH decreased considerably from 6.44 to 5.87, on average ($p < 0.05$).

It was found that there was slightly increase in Water activity from 0.85 to 0.86 in stuffed bitter gourd, 0.90 to 0.92 in stuffed brinjal and 0.89 to 0.91 in stuffed potato for 30 days of storage period.

Titrable acidity as expressed as % Lactic acid was found to be decreased in the stored stuffed vegetable samples. Stuffed brinjal showed marginal decrease whereas stuffed potato and bitter gourd showed more difference in the acidity value for 30 days of storage period. The titrable acidity of chemically and thermally treated bitter gourd samples on day first was found to be 0.038 to 0.051% that gradually increased to 0.057 to 0.061% Lactic acid in six months storage [30]. According to (Nourian) [39], the total acidity of tubers increased from 0.06% to 0.12% after 133 days of storage at 4°C. (Drake) [40] found that titratable acidity (TA) of "Gala" apples was reduced at irradiation doses of 0.60 kg and above. On the other hand no loss of TA due to the irradiation dose was evident, for "Fuji" or "Granny Smith" apples.

Peroxide value showed increase in all the three stuffed vegetables. As the values shown in Table 3 indicates that, in the stuffed potato samples the increase was more when compared to that of stuffed bitter gourd and brinjal. (Melton) [41], reported that there is no effect on storing condition and the type of oil on peroxide value, however by increasing storage time peroxide value increases and if reaches more than 0.5% is no longer appropriate for frying and if still consumes results in reduction of shelf life.

As shown in Table 3, it was observed that there was increase in free fatty acid (%/gm) value. The value of free fatty acid was seen in higher percentage in stuffed brinjal followed stuffed bitter gourd and stuffed potato.

All the three stuffed vegetables showed an increase in TBA values (mg/malonaldehyde/kg) during storage. In stuffed bitter gourd TBA increased to 0.96 from the initial value 0.23, in stuffed brinjal from 0.20 to 0.92, and stuffed potato from 0.19 to 0.93 mEqO2/gm of the samples for 30 days of period.

Colour parameters

The values for colour varied significantly ($p \leq 0.05$) in all the three stuffed vegetables during storage as shown in Table 4. The 'a' value found to be the maximum greenness and maximum purplish in the initial samples of bitter gourd and brinjal respectively, while storage the colour intensity was reduced.

Changes in L and a values have been used in monitoring enzymatic browning on fresh cut fruits and vegetables [42,43].

Sensory Parameters

Overall acceptability is the sum of different quality attributes which have a bearing on consumer perception towards the acceptance or rejection of a product. The results on the changes in sensory parameters during storage of stuffed vegetable products are given in Table 5. The initial acceptability score of stuffed - bitter gourd and brinjal was 8.1 and potato was 8.2 on 9 point hedonic scale and decreased slowly with the storage period after 30 days of storage, maintaining the acceptance of product. In general, any product with the score of below 6 is on the non-acceptance. Though the product was acceptable during storage, the temperature of storage influenced the scores.

Microbial quality

The stuffed vegetable samples were evaluated for its microbial quality are presented in Table 6. The microbiological analysis clearly shows the sterilized condition of the product, Coliform was nil upto 30 days of storage period reflecting the safety of the product. Processing treatment such as vacuum packaging helped to reduce coliforms and anaerobic bacteria in potatoes and helped to increase the shelf life. (Bari) [44], reported that the appearance, colour, texture, taste, and overall acceptability of broccoli and moong bean sprouts, irradiated at 1.0 kg, did not undergo significant changes after seven days of post-irradiation storage at 4°C, in comparison with control samples. (Song) [45], reported that the initial populations of the total aerobic bacteria and coliform counts observed in the carrot juice were 106 CFU/ml, and those of the kale juice were 107 CFU/ml. All the aerobic bacteria and coliforms in the fresh carrot juice were eliminated with irradiation at 3 kg and the D10 value of the microflora in the carrot juice was found to be approximately 0.5 kg. However, a radiation dose up to 5 kg could not completely eliminate the bacteria in the fresh kale juice. The D10 value was higher than 1.0 kg in the kale juice. This result indicated that the microflora of the kale and carrot juice is fairly different. A series of experiments to examine the effects of gamma irradiation (1, 2, and 3 kg) on coriander leaves (Coriandrum sativum L.) stored in polyethylene sachets at 8–10°C was performed by [46]. The initial total bacterial and mold counts observed in coriander leaves ranged between 106 to 108 CFU/g and 103–104 CFU/g, respectively. All the samples contained Listeria, Yersinia, and fecal coliforms prior to irradiation. Dose of 1kg resulted in three log cycles reduction of bacteria, 1 log kill of yeast and mould and reduction of coliform to 43 CFU/g. The Listeria and Yersinia present in the product were eliminated by such a low-dose treatment.

CONCLUSION

From the study it can concluded that the storage stability studies were carried out for Three stuffed vegetables viz., bitter gourd, brinjal and potato which were developed with combination preservation technologies by storing at ambient temperature and evaluated periodically for functional, nutritional, quality and sensory parameters. The RTE Stuffed products were stable upto 30 days and microbiological analysis of products developed showed the sterilized condition of the products. Since vegetables are rich in micronutrients and functional components, the present study which brought three RTE stuffed vegetables, which was having shelf life of 30 days is a having benefit which will be meeting the nutritional requirements. Ready-to-eat food reduces the cooking time and with no additional preparation, people with busy schedule can opt these products and have the advantage of meeting nutritional requirements.

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