



Studies on shelf life of soypaneer by vacuum packaging at room temperature

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Abstract

The study aimed at the improvement of shelf life of protein rich soypaneer, which can be consumed in developing countries such as India to overcome protein-energy malnutrition. Soypaneer was prepared by standard procedure and was packed with two different methods viz. vacuum and aerobic packaging in LDPE packaging material of varying gauges i.e. 150, 200 and 300. The storability of the soypaneer with vacuum packaging and aerobic packaging at room temperature with LDPE packaging material of different gauges was evaluated, so that better packaging method and packaging material could be selected with estimation of shelf life of soypaneer. Quality attributes of soypaneer samples determined during storage of 24 hrs were moisture content, pH, titratable acidity, standard plate counts, yeast and mould counts, texture (hardness) and organoleptic properties. In storage study of soypaneer samples it was observed that vacuum packed soypaneer samples were acceptable upto 15 hrs and with aerobic packaging upto 6 hrs from zero hour. Among the packaging materials, LDPE with 200 gauge was found to be most effective packaging material for better storability of soypaneer at room temperature. Thus, the study reveals that vacuum packaging successfully increased the shelf life of soypaneer at room temperature as compared to aerobic packaging.

Keywords: Aerobic packaging, LDPE, organoleptic properties

Introduction

Soybean is a food legume and an excellent source of nutrition and health promoting phyto-chemical at an affordable price. Soybean is rich in edible oil of 18-20 % and considered as cheapest source of high-quality protein 40 %, 23 % carbohydrate and about 5 % ash. The average domestic production of soybean in India is around 8.76 million tones with an average area of 8.82 million hectare. Several potential health benefits have been attributed to consumption of soy foods. The soypaneer is one of the most nutritional products that can be prepared from soymilk from 1 kg of cleaned and dry soybean about 6-8 litres of milk and after coagulation of milk about 1.5 – 2 kg of soypaneer can be obtained. Soypaneer has a limited shelf life because of its high moisture content and high-water activity. The shelf life of soypaneer is normally 3 to 6 hrs at room temperature and 3 weeks under refrigeration (Grover *et al.*, 1983) ^[6]. Therefore, it is highly susceptible for growth of micro-organisms. Presently milk paneer is available in the market in polythene pack (200 gm). Similar trend of packaging could be adopted for soypaneer. Vacuum packaging is one of the easiest, most efficient and economical process of preserving quality and safe storage of dairy products. Vacuum packaging literally vacuums the air out of the bags or storage containers, and so slows the process of deterioration. The storage life of soypaneer also depends on storage temperature as the vendors keep soypaneer for sale at room temperature. The recent commercial popularity of soypaneer has prompted the establishment of many new businesses engaged in soypaneer production. This industrial interest has led to extensive research concerning the processing and organoleptic quality of soypaneer, but till date, very little work has been noted on microbiological quality and other quality attributes of commercial soypaneer during storage. Therefore, it was necessary to study effect of packaging methods and packaging materials on quality

attributes of soypaneer to estimate its shelf life at room temperature.

Material and Methods

Well graded JS-335 soybean variety was used for study. Soybean was procured from Soybean Research Center, Marathwada Krishi Vidyapeeth, Parbhani.

Preparation of Soypaneer

2 kg soybean seeds were soaked in water for 6-8 hrs. Further, drained, rinsed and ground with 15 liters of water. The resultant slurry was cooked at 100 °C to eliminate beany flavour and anti nutritional factors. Then slurry was strained through double layered muslin cloth to obtain soymilk. Soymilk was further heated to 70 °C and then coagulated with citric acid 2 gm per liter of milk with slow stirring for few minutes and held at room temperature for 15 min to coagulate. The curd lined with double layered muslin cloth was gently transferred to perforated stainless steel paneer press and pressed for 15 min. After separation of whey, soypaneer block was obtained.

Packaging and Storage

Prepared soypaneer was then cut into blocks of 100 gm and packed in two different methods of packaging i.e. vacuum packaging and aerobic packaging. LDPE packaging materials with different gauges i.e. 150, 200 and 300 were used for packaging of soypaneer and were kept for storage study at room temperature. Different properties of soypaneer such as moisture content, pH, titratable acidity, textural quality and microbial counts were determined at room temperature storage conditions. Moisture content was determined as per the procedure given in BIS (1981). The method proposed by Arora and Gupta (1980) ^[2] was used to determine pH of soypaneer. Titratable acidity was determined by method proposed by Ranganna (1986) ^[12].

Microbial examination was carried out as per method cited in Indian Standard Institute, ISI (1969) [8]. Texture analysis was done using Texture Profile Analyzer Stable Micro Systems as per the method suggested by Bourne (1968) [4]. Sensory evaluation was carried out by standard method (ISI 1971 a-1971b).

Statistical Analysis

Data of different quality attributes such as moisture content, pH, titratable acidity, standard plate counts, yeast and mould counts, textural values and sensory scores during storage at room temperature for vacuum packed and aerobic packed samples were tabulated and statistically analyzed by twoway analysis of variances in triplicates.

Results and Discussion

Moisture content

It was observed from figure 1 that initial moisture content of fresh soypaneer was noted as 70.56 percent (w.b.). There was fluctuation in moisture content during storage of 24 hrs. In vacuum packed samples, as the storage period increased the moisture content decreased from 0 hr to 12 hr of storage followed by gradual increase upto the end of storage i.e. 24 hrs. It was observed that initial loss in moisture content was maximum in soypaneer vacuum packed in LDPE pouch with 300 gauge (P₃V) i.e. 1.35 percent and least changes were observed in soypaneer vacuum packed in LDPE pouch with 200 gauge (P₂V) i.e. 0.6 percent. In aerobic packaging the moisture content decreased from 0 hr to 6 hrs of storage

and gradually increased on 9th hr. Maximum decrease was observed in soypaneer samples with aerobic packaging in LDPE with 300 gauge (P₃A) and minimum change in moisture content was observed in soypaneer with aerobic packaging in LDPE pouch with 200 gauge (P₂A). It was observed that moisture content of soypaneer with vacuum and aerobic packaging showed significant difference on packaging materials and storage intervals and its interaction term.

Initial decrease in moisture content may be due to the syneresis in protein gel of soypaneer during storage which is caused by an increase in cross-linking among protein molecules through various interactions, making protein gel matrix denser. Thus, with the increase in storage period, increase in syneresis rate must have caused the oozing of water from soypaneer which then accumulates in packages. Further disintegration of protein and oxidation of lipid globules would have loosened the gel structure of soypaneer and thereby allowed absorption of oozed water which may be reason for increase in moisture content from 15th hr and 9th hr of storage of soypaneer with vacuum packaging and aerobic packaging, respectively. Similar observations were noted by Anbarasu and Vijayalakshmi (2007) [1]. Among the packaging materials, it was observed that in both treatments i.e. vacuum packaging and aerobic packaging of soypaneer stored at room temperature, minimum changes in moisture content were observed in LDPE pouch with 200 gauge as compared to LDPE with 150 and 300 gauge. Hence LDPE with 200 gauge was most suitable packaging material.

Table 1: Analysis of Variance for quality attributes of vacuum packed soypaneer stored at room temperature.

Source of variation	d.f.	Moisture	pH	Titratable acidity	Standard plate counts	Yeast and mould counts	Hardness
Packaging materials (P)	2	106.72**	4.266**	0.0752**	328.3**	124.58**	238514**
Storage Intervals (I)	8	8.899**	0.6459**	0.014**	785.03**	4.297**	1620**
P x I	16	4.7921**	0.1773**	0.0003**	654.1**	3.674**	48351**
Error	54	1.1002	0.0163	0.0003	3.4762	1.8276	5841.7

Table 2: Analysis of Variance for quality attributes of aerobic packed soypaneer stored at room temperature.

Source of variation	d.f.	Moisture	pH	Titratable acidity	Standard plate counts	Yeast and mould counts	Hardness
Packaging materials (P)	2	11.775**	0.6325**	0.0118**	4386.6**	67.49**	28847**
Storage Intervals (I)	3	2.1699**	0.047**	0.0015**	3426.56**	41.63**	1836**
P x I	6	5.0182**	0.0024**	0.0098**	5648.34**	5.063**	50878**
Error	24	0.6033	0.0044	0.0002	74.876	2.6783	2231.3

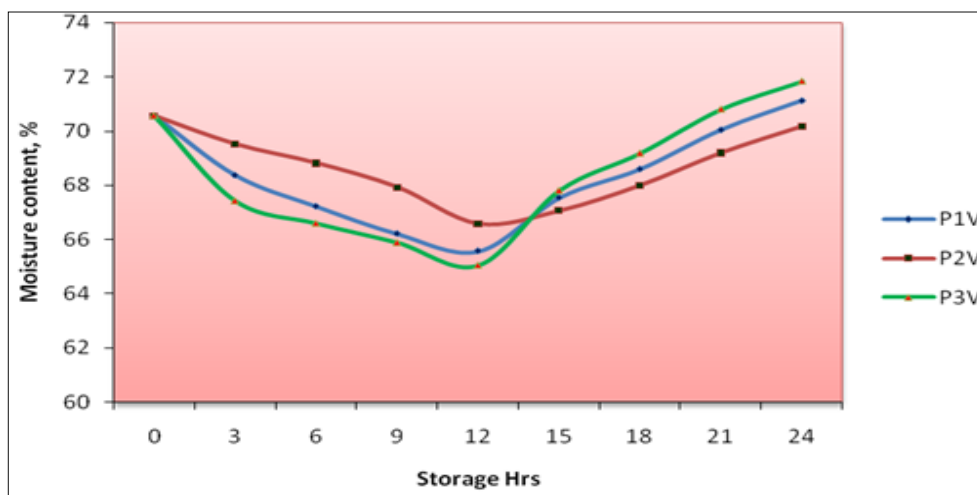


Fig 1: Effect of vacuum packaging of soypaneer on moisture content during storage.

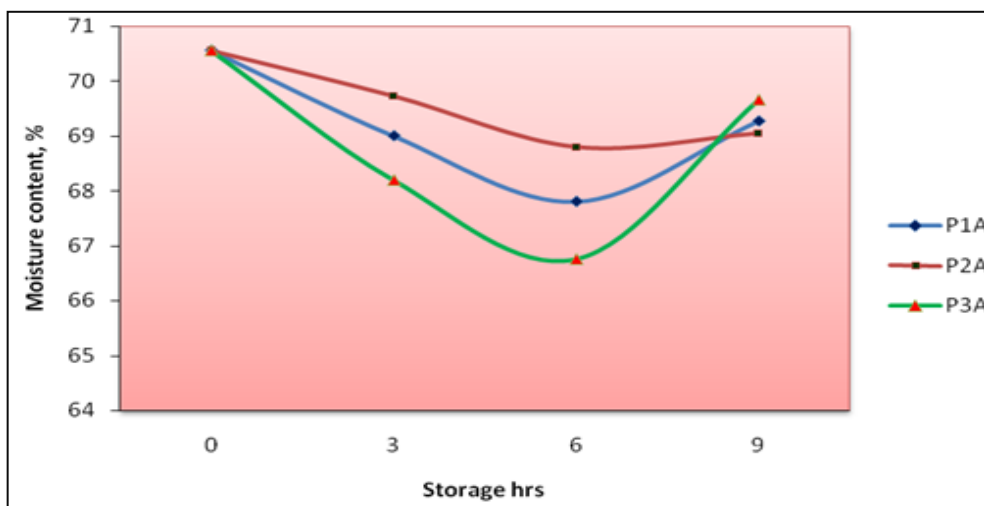


Fig 2: Effect of aerobic packaging of soypaneer on moisture content during storage.

pH

The pH of fresh soypaneer was 4.83. It was observed that pH of vacuum and aerobic packed soypaneer increased with storage period. The rate of increase in pH was more in aerobic packaging as compared to vacuum packaging. Among packaging materials, LDPE with 200 gauge showed minimum increase in pH of vacuum and aerobic packed soypaneer samples during storage of 24 hrs. Anbarasu and Vijayalakshmi (2007) ^[1] reported that the pH value of soypaneer varies from the range 4 to 6. Similar range of pH value was noted in present study. Variation in pH was from 4.83 to 6.0 within 24 hrs of storage for soypaneer samples with vacuum packaging and from 4.83 to 5.84 within 9 hrs of storage for soypaneer samples with aerobic packaging. This change in pH value was within safe limit and do not affect much on shelf life of soypaneer during storage period. Change in pH values of soypaneer occurred during storage may be due to the decomposition or degradation of protein by micro-organisms. Growth of micro-organisms causes rapid decomposition of protein and change in pH. According to Anbarasu and Vijayalakshmi (2007) ^[1], pH of soypaneer increased or decreased on type of contaminating micro-organisms

Titrateable acidity

The initial value of fresh soypaneer was 0.43 percent. From Table 4.21 and 4.22 it was observed that titrateable acidity varied from 0.43 to 0.27 percent for soypaneer samples with vacuum packaging during storage of 24 hrs and 0.4 to 0.26 percent for soypaneer samples with aerobic packaging during storage of 9 hrs. Decrease in titrateable acidity was observed for all the samples stored at room temperature. Decrease in titrateable acidity of aerobic packed soypaneer was higher than vacuum packed. Minimum decrease in titrateable acidity was observed in LDPE with 200 gauge as compared to 300 and 150 gauges for both packaging methods i.e. vacuum and aerobic packaging of soypaneer during storage. Such decrease in titrateable acidity of all the samples i.e. vacuum packed and aerobic packed was in accordance with the increase in the pH value.

Microbial counts

Standard plate counts

It was observed that standard plate counts of soypaneer increased with increase in storage period for vacuum packed

and aerobic packed samples stored at room temperature. Initial standard plate counts on fresh soypaneer were 27 CFU/gm which is very less and negligible. In vacuum packed samples, standard plate counts increased from 27 CFU/gm to 4.5×10^4 CFU/gm during 18 hrs of storage. Further increase in standard plate counts was too numerable to count hence the counts were not measured after 18 hrs of storage. Gandhi (2009) ^[5] had given the nutritional standards for soypaneer and quoted the critical limit of SPC as 20000 CFU/gm. Considering this standard critical limit of SPC, all the samples with vacuum packaging in LDPE pouches of 150, 200 and gauge i.e. P₁V, P₂V and P₃V were within safe limit upto 15th hr of storage but further on 18th hr the microbial attack increased drastically and beyond the standard limit, making product unsafe for consumption. In aerobic packaging the microbial attack varied from 27 CFU/gm to maximum 6.5×10^5 CFU/gm during 9 hrs of storage. All the samples were within the safe limit of SPC, upto 6 hrs of storage and became unsafe and unacceptable on 9th hr as microbial attack increased drastically. LDPE with 200 gauge was less affected by microbes as compared to LDPE with 300 and 150 gauge. Hence, it was concluded that packaging material with 200 gauge was able to protect the microbial attack on soypaneer as compared to 150 and 300 gauge.

Yeast and mould counts

Yeast and mould counts of fresh soypaneer was measured as 28 CFU/gm which was very less and negligible. It was observed that yeast and mould counts for vacuum packed soypaneer varied from 28 CFU/gm to 4378 CFU/gm during storage of 21 hrs and for aerobic packed soypaneer varied from 28 CFU/gm to 9062 CFU/gm during storage of 9 hrs. It was observed that aerobic packed soypaneer samples recorded more counts as compared to vacuum packed soypaneer samples during storage. Gandhi (2009) ^[5] quoted the quality standards for yeast and mould counts. From this reference, all vacuum-packed samples were within safe limit of yeast and mould counts from 0 hr to 15 hrs of storage. Further increase in yeast and mould counts beyond the safe limit and the samples were spoiled and discarded at 18th hr of storage. All the soypaneer samples with aerobic packaging were within the safe limit of yeast and mould counts upto 6th hr of storage. Later on 9th hr the counts

were beyond the standard limits as it increased drastically. Sticky layer on surface of soypaneer was observed on 9th hr of storage this may be due to the growth of yeast and mould. Hence, soypaneer samples with aerobic packaging at room temperature were safe for consumption upto 6 hrs only. LDPE with 300 gauge had more yeast and mould growth and minimum growth was recorded in LDPE with 200-gauge samples.

Textural properties (hardness)

Hardness value of fresh soypaneer was 631.9 gm. Increasing trend was found in hardness value of soypaneer packed in different packaging materials during storage. Similar phenomenon was observed by Bargale and Jha (1992) and Uprit and Mishra (2004) [3, 13]. Further it was observed that hardness value of all the samples decreased on 18th hr of storage making all the samples soft with water accumulation in packs. It was observed that the rate of decrease in hardness value was more in soypaneer samples in vacuum packed in LDPE 300 gauge (P₃V). The hardness value of all the samples increased consistently as the storage period increases upto 12th hr and 6th hr in vacuum packaging and aerobic packaging of soypaneer, respectively. However sudden fall in hardness value was observed on 18th hr and 9th hr in vacuum packaging and aerobic packaging, respectively. This change in hardness value was in accordance with change in moisture of soypaneer. The initial increase in hardness value may be due to syneresis in protein gel that causes oozing of water. Further this water gets accumulated in packages that cause loosening of gel structure of soypaneer and thereby allowing absorption of more water which may be the reason for increase in moisture content and decrease in hardness of soypaneer at the end of storage i.e. from 15th hr and 9th hr with vacuum packaging and aerobic packaging, respectively. However, the rate of decrease in hardness value of soypaneer samples was more in LDPE pouch with 300 gauge. This may be due to lowest water vapour transmission rate of LDPE with 300 gauge as compared to LDPE pouch with 150 and 200 gauge. Gyanendra and Srinivasan (1983) [7] reported water vapour transmission rate for 150, 200- and 300-gauge LDPE packaging material as 11.5, 7.3 and 5.9 g/m²/24 hr respectively.

Sensory evaluation

Subjective evaluation of vacuum packed soypaneer in LDPE of three different gauges was performed by 9 judges from 0 hr to 18th hr for varying period of storage intervals of 3 hrs. Vacuum packed samples were discarded on 18th hr of storage with respect to various quality attributes viz. colour and appearance, flavour, taste, body and texture and overall acceptability. Similarly, sensory evaluation of aerobic packed samples was done by 9 judges from 0 hr to 9th hr with the storage interval of 3 hrs. Aerobic packed samples were discarded on 9th hr of storage with respect to various quality attributes viz. colour and appearance, flavour, taste, body and texture and overall acceptability.

Conclusions

Evaluation of best packaging material and shelf life of soypaneer was done as per the results obtained for changes in moisture content, pH, titratable acidity, microbial counts, yeast and mould counts, hardness value and sensory evaluation during storage. Microbial counts and sensory

qualities had dominating effect on shelf life of soypaneer and hence considered for determination of shelf life. From the results it was observed that vacuum packaging treatment was best suitable to enhance the shelf life of soypaneer as compared to aerobic packaging. Shelf life of vacuum packed soypaneer samples at room temperature was 15 hrs and that of aerobic packed soypaneer samples had shelf life of 6 hr at room temperature. 60 percent increase in shelf life of soypaneer was observed in vacuum packed soypaneer samples over aerobic packed soypaneer samples. Among the packaging materials, LDPE with 200 gauge was most suitable for soypaneer with vacuum packaging and aerobic packaging for storage.

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