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Storage Stability of Retort Pouch Processed Mini Chevon Patties Incorporated with Sesame Seed Paste

Jeyapriya, S.[1], Uttam Kumar Pal[1]*, Rajkumar, V.[2] and Prabhat Kumar Mandal[1]

[1]Department of Livestock Products Technology, Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry, INDIA

[2]Central Institute for Research on Goats, Makhdoom, U.P., INDIA

**Corresponding author: UK Pal; E-mail: paluttamkumar@gmail.com*

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ABSTRACT

A study was conducted to investigate the storage stability of low fat mini chevon patties. Control patties sample contained 70% goat meat and 7 % goat fat. Treated sample patties have similar percentage of goat meat but the goat fat was replaced with 2.8% sesame seed paste, which was calculated to be 40% of goat fat replacement in the formulation. Patties were retort processed at 121.1°C for 15 minutes. Changes in physico-chemical, microbiological and sensory qualities of retort pouch processed chevon patties were monitored at 15 days interval for 90 days of storage at ambient temperature. The TBARS, tyrosine and free fatty acid values were well below the threshold limits in all the samples but the values increased significantly ($P<0.05$) from 0 to 90 days of storage. The pH values decreased significantly ($P<0.05$) with the progress of storage but values were within the acceptable limits. No bacterial colonies could be detected through standard plate count, anaerobic count, *Clostridium botulinum*, yeast and mould counts during the storage study. There was significant ($P<0.05$) decrease in sensory scores with the advancement of storage but scores for all the sensory parameters remained between 6.16 to 7.49 on eight point hedonic scale indicating very good acceptability of the products. The findings of this study revealed that retort pouch processed low fat mini chevon patties containing sesame seed paste had a shelf life of 3 months at ambient temperature.

HIGHLIGHTS

- Developed retort processed patties are ready to eat and has the convenience of boiling in bag.
- These retorted patties can be stored at room temperature easily.
- Prolonged storage of retorted products will pose a good market.

Keywords: Chevon patties, shelf-life, retort pouch, sesame seed paste, ambient temperature

Thermal processing is a highly effective method of food preservation. It involves the use of controlled heat energy to process and preserve foods, and it is one of the key processes used in making packaged shelf stable food products (Gokhale and Lele, 2014). The hermetic seal preserves an environment in the container that prohibits the growth of additional bacteria with higher resistance and, more significantly, prevents recontamination and pathogens from generating toxins during storage (Chiozzi *et al*., 2022). Pouches made from aluminium foil offer a longer shelf life in terms of quality. The shelf-life of a retorted food product is approximately two years for an aluminium foil pouch (Vijitpunyaruk, 2022).

The transition from traditional rigid containers, such as metal cans, to flexible pouches has been driven by the distinct advantages given by flexible packaging materials. The advantage of flexible packaging

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is that it makes better use of packaging material and packaging space, lowering costs related with storage and transportation as well as waste disposal. Retort processing allows us to deliver ready-to-eat processed food products that remain stable at room temperature (Tribuzi *et al*., 2015). This unique type of food has been defined as a catering system based on partial cooking of food which involves thermal processing at high temperatures, storage in ambient conditions, and subsequent thorough re-heating before consumption.

Researchers found that using retortable pouches for a variety of products was desirable such as fresh water prawn curry (Majumdar *et al*., 2016), chettinad style pepper chicken curry (Nalini *et al*., 2018), eel steaks in curry medium (Mugale *et al*., 2018), beef redang (Praharasti *et al*., 2019), samyetang marinated with soy sauce (Kim *et al*., 2020) and shrimp masala (Gouthamy *et al*., 2021). Thus the present study was planned to assess the shelf life of retort pouch processed mini chevon patties at ambient temperature upto 90 days.

MATERIALS AND METHODS

Preparation of mini chevon patties

The mini chevon patties were prepared as per our earlier study (Jeyapriya *et al*., 2023). In simple terms, ice flakes, curing materials, and chopped chevon were placed in a food processor. Following the addition of goat fat/sesame seed paste (2.8% SSP) to the mixture, the protein was extracted by chopping for three minutes at a high speed. For the last 30 seconds, the process was repeated with the addition of the binder (maida), dry spice mix, and green condiments to create the batter. Using petri plates (40 mm internal diameter × 12 mm height), raw patties with an average weight of 25 grams were formed from the prepared batter. The patties were cooked for 30 minutes, or until the internal core temperature reached 80ºC, in an electrical grilling oven that had been preheated to 180ºC. To achieve equal cooking, the patties were turned after 15 minutes of cooking. After the making of the control and treatment (2.8% SSP) patties, the products were processed in retort pouches.

Preparation of retort pouch processed mini chevon patties

For this study, retort pouches with a three-layer design and dimensions of 20 cm by 15 cm—provided by M/s Lakshmi Engineering, Chennai—were used. The freshly made mini chevon patties from the control and 2.8% SSP-treated groups were placed into the pouches, with 100g in each, and vacuum-packed to ensure quick sealing. It facilitates the extraction of the pouch's head space air (Model 19/s, Roscherwerke GmbH, Germany). In order to examine the process control parameters, a sufficient number of pouches with thermocouples carefully affixed to the core of chevon patties were loaded. Thermal processing was applied to the filled and sealed pouches by keeping the retort temperature at 121.1ºC. Throughout the operation, a steam and water air mixture was used for heating and cooling, with a constant pressure of 20 psi. Cooling water was circulated to achieve rapid cooling. Following processing, each pouch was dried and stored at room temperature (between 25 and 300 degrees Celsius) in a dust-proof cabinet. Ultimately, the shelf life of the 2.8% SSP-incorporated mini chevon patties and the control retort-processed patties was investigated under room temperature for up to three months of storage at intervals of fifteen days. Shelf life studies were repeated three times. Shelf life studies included changes in the physicochemical, microbiological and sensory traits.

Quality parameters

pH of the control and treated patties was determined by following the procedure of (AOAC, 1995). Thiobarbituric acid (TBA) value was estimated by extraction method described by (Tarladgis *et al*., 1970) and was expressed as mg malonaldehyde(MA) per kg of sample. The procedure for (Strange *et al*., 1977) was followed for the tyrosine value. Tyrosine value was calculated and expressed as mg of tyrosine per 100g of sample. Estimation of free fatty

acid content was done as per (Konieko, 1979). All the microbiological parameters standard plate count, anaerobic count, Clostridium botulinum, yeast and mould count were determined by using standard methods of (APHA, 1984). Readymade media (Hi-Media, India) were used for all the microbiological examination. All the freshly prepared products were subjected to sensory evaluation using 8 point hedonic scale. Sensory evaluation of the samples was carried out as described by (Keeton, 1983). The data generated from this study were subjected to statistical analysis by standard procedures like analysis of variance (ANOVA) using SPSS software 17. The data recorded in this experiment were analyzed using two way ANOVA. Significant difference were tested using the Least Significance Difference Test (LSD) as per (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

Tyrosine value (mg/100g)

Tyrosine value (TV) increased significantly ($P<0.05$) from 0 to 90th day of storage in treated and in control samples during entire storage. There was significant ($P<0.05$) difference in tyrosine values between all the days of storage for treatment groups. For control samples no significant differences were recorded in tyrosine values between 45 and 60 days and again between 75 and 90th day of storage.

TV is an indicator of microbial spoilage in muscle foods, as it measures tyrosine and tryptophan in the extract of meat due to proteolysis during storage. TV of meat increased with storage time until deamination of amino acid limited the formation of free amino acid (Pearson, 1968; Dushyanthan *et al*., 2001; Rajkumar *et al*., 2001). Control patties recorded significantly ($P<0.05$) higher tyrosine values than treatment patties. Lower tyrosine value in treatment patties might be due to the effect of superior antimicrobial property of added sesame seed (Morris, 2002). Similar trends in increasing tyrosine values in retort processed buffalo meat blocks and goat meat products during storage at ambient temperature were reported by Devadason (2014) and (Rajkumar *et al*., 2010), respectively. (Chandirasekaran *et al*., 2016; Nalini *et al*., 2018) also reported increasing trends in tyrosine values in retort processed chettinad chicken and pepper chicken, respectively during storage of products at ambient temperature.

TBARS (mg malonaldehyde/kg)

The TBARS values (mg malonaldehyde/kg) of control and 2.8% SSP added retort processed chevon patties during ambient temperature storage ranged between 0.52±0.03 to 0.68±0.05 and 0.49±0.03 to 0.65±0.03, respectively. A slow but increasing trend of TBARS value was noticed in both control and treatment sample as the storage progressed. There was significant ($P<0.05$) increase in TBARS value in control groups between 0 and 15th day, 45th and 60th day whereas in treatment group increase was noticed between 15th and 30th day, 45th and 60th day and 60th and 75th day. Higher TBARS values in control samples might be due to higher fat content which was responsible for more oxidation. (Cyprian *et al*., 2017) observed higher TBARS values in groups with higher lipid content. Comparatively lower TBARS values in 2.8% SSP treated sample might be due to higher oxidative stability of sesame as it was reported to contain natural antioxidants such as tocopherols, sesamin and sesamolin (Elleuch *et al*., 2007; Lee *et al*., 2008).

Similar increase in TBARS values during storage have been reported by Rajkumar *et al*. (2010) in retort processed goat meat curry, Devadason *et al*. (2014) in buffalo meat blocks, Rajan *et al*. (2014) in chettinad chicken product and Priyanka *et al*. (2017) in retort pouch processed cereal based chicken stew.

Linear increase in TBARS might be due to lipid oxidation of meat, however, slow progressive increase may be due to formation of antioxidants at high sterilization temperature (Zipser and watts, 1961). However, the TBARS values on the 90th day in both samples during storage period were well below the threshold value of 1-2 mg malonaldehyde/kg (Watts, 1962).

Free fatty acid (FFA)

Free fatty acid content can be considered as an

indicator of lipid oxidation and deterioration in flavor of the product. There was a significant (P<0.05) increase in free fatty acid values from 0 day to 45th day followed by increase on 75th day of storage for control samples. In treated samples no significant differences were recorded between 15th and 30th day and between 45th, 60th and 75th days of storage.

The 2.8% SSP treated patties recorded slightly lower FFA values than control patties. This might be due to the ability of some compounds in sesame to act as hydrogen donors which are the primary antioxidants that react with free radicals (Elleuch *et al*., 2007). This low lipolytic activity in treated patties might be also due to presence of phenolics and flavonoids present in vegetable oilseeds (Shagufta *et al*., 2013; Francisco and Resurreccion., 2008).

Similar to the findings of the present study, (Dileep *et al*., 2012) reported an increase in free fatty acid in retort processed squid curry during a storage period of 90 days. Kowale *et al*. (2005) reported that any product with FFA level of greater than 3% (as % of oleic acid) could be considered as inedible. In the present study FFA values were well below 3% in both the products during entire period of storage.

pH

Physicochemical properties of retort pouch processed (control and 2.8% SSP treated) mini chevon patties during storage upto 3 months at ambient temperature are presented in Table 1. The pH of control and 2.8% SSP incorporated mini chevon patties ranged between 6.14±0.01 to 6.37±0.01 and 6.13±0.01 to 6.34±0.01, respectively during storage. The pH values for control samples were significantly (P<0.05) lower from 30th day onwards upto 90th day of storage compared to pH on 0 day. Treatment samples had comparable pH upto 30th day and significant (P<0.05) differences in pH were observed on 45th day onwards upto 90th day of storage.

(Rajkumar *et al*., 2010, Devadason *et al*., 2014, Nalini *et al*., 2015) recorded pH values similar to the values found in the present study in retort processed chettinad goat meat, retort processed buffalo meat block and retort pouch processed chettinad style chicken respectively. Similar to the findings in this study a fall in pH of different retort processed chicken products such as chettinad chicken, cereal based chicken stew and pepper chicken during storage at ambient temperature were reported by different

Table 1: Effect on physico-chemical properties of retort pouch processed mini chevon patties during storage upto 3 months at ambient temperature

Parameter	Storage days						
	0	**15**	**30**	**45**	**60**	**75**	**90**
Tyrosine values							
Control	6.30±0.14^{a}	6.63±0.11^{b}	6.82±0.09^{c}	7.13±0.06^{d}	7.16±0.05^{d}	7.29±0.04^{e}	7.38±0.03^{e}
Treatment	6.08±0.05^{a}	6.33±0.09^{b}	6.55±0.09^{c}	6.75±0.09^{d}	6.88±0.06^{e}	7.08±0.04^{f}	7.16±0.02^{g}
TBARS values							
Control	0.52±0.03^{a}	0.54±0.03^{ab}	0.58±0.03^{bc}	0.61±0.05^{cd}	0.63±0.03^{e}	0.66±0.04^{de}	0.68±0.05^{ef}
Treatment	0.49±0.03^{a}	0.50±0.02^{a}	0.52±0.03^{ab}	0.55±0.03^{b}	0.60±0.03^{c}	0.64±0.03^{de}	0.65±0.03^{e}
FFA values							
Control	0.26±0.05^{a}	0.35±0.03^{b}	0.41±0.04^{c}	0.50±0.04^{d}	0.49±0.04^{d}	0.55±0.08^{e}	0.57±0.05^{e}
Treatment	0.23±0.04^{a}	0.34±0.05^{b}	0.39±0.08^{b}	0.46±0.04^{c}	0.48±0.03^{c}	0.50±0.05^{c}	0.54±0.04^{d}
pH values							
Control	6.37±0.01^{f}	6.33±0.01^{ef}	6.31±0.01^{e}	6.27±0.01^{cd}	6.24±0.01^{c}	6.19±0.01^{b}	6.14±0.01^{a}
Treatment	6.34±0.01^{d}	6.31±0.01^{d}	6.30±0.01^{d}	6.26±0.01^{c}	6.23±0.01^{c}	6.18±0.01^{b}	6.13±0.01^{a}

Means bearing superscripts in rows differ significantly (P ≤0.05).

researchers (Chandirasekaran *et al*., 2015; Priyanka *et al*., 2017 and Nalini *et al*., 2018) which might be due to degradation of protein and liberation of free amino acids.

Effect of storage on microbial quality of retort processed mini chevon patties during storage

No colony forming unit (cfu) for standard plate count, anaerobic count, *Clostridium botulinum* and yeast and mould count were detected in any of the control and treated samples over the entire period of storage. The microbiological analysis of control and treated patties showed that the product remained commercially sterile during the entire period of storage at the ambient temperature storage and confirmed the adequacy of the processing as well as fitness of the product for consumption.

The absence of microbial growth during the entire period of storage in the present study might be attributed to the good hygienic practices followed during processing, and the optimal thermal processing schedule followed.

The results of the study were similar to the findings of (Devadason *et al*., 2014) who also observed no microbial growth in retort processed buffalo meat chunks. Similarly, (Priyanka *et al*., 2017) also could not detect any microbial growth in retort processed cereal based chicken stew.

Effect of storage on sensory quality of retort processed mini chevon patties

Effect on sensory properties of retort pouch processed mini chevon patties on storage upto 3 months at ambient temperature are presented in Table 2. The appearance scores for control and treatment ranged between 7.32±0.12 to 7.56±0.11 and 6.83±0.13 to 7.25±0.12, respectively. No significant (P>0.05) differences were recorded in appearance scores for both control and treatment samples from 15 to 90 days of storage at ambient temperature. Similar to the results of the present study, slight decline in appearance scores were reported by (Rajkumar *et al*., 2010; Devadason *et al*., 2014; Nalini *et al*., 2018) in ready to chettinad goat meat curry, buffalo

Table 2: Effect on sensory properties of retort pouch processed mini chevon patties on storage upto 3 months at ambient temperature

Parameter	Storage days						
	0	15	30	45	60	75	90
Appearance values							
Control	7.56±0.11^{b}	7.40±0.12^{a}	7.39±0.11^{a}	7.37±0.13^{a}	7.34±0.12^{a}	7.32±0.13^{a}	7.32±0.14^{a}
Treatment	7.25±0.12^{b}	7.19±0.15^{a}	7.08±0.14^{a}	7.08±0.16^{a}	7.08±0.11^{a}	6.99±0.10^{a}	6.83±0.13^{a}
Flavour values							
Control	7.78±0.12^{f}	7.72±0.15^{e}	7.54±0.16^{d}	7.50±0.13^{c}	7.50±0.14^{c}	7.39±0.11^{a}	7.49±0.12^{b}
Treatment	7.47±0.14^{d}	7.37±0.15^{c}	7.36±0.14^{b}	7.28±0.15^{a}	7.27±0.13^{a}	7.27±0.14^{a}	7.25±0.13^{a}
Texture values							
Control	7.66±0.12^{a}	7.62±0.14^{a}	7.41±0.13^{b}	7.25±0.14^{c}	7.12±0.15^{d}	6.75±0.12^{e}	6.75±0.13^{e}
Treatment	7.37±0.13^{a}	7.37±0.12^{a}	7.25±0.11^{b}	7.12±0.16^{c}	6.80±0.13^{d}	6.62±0.11^{e}	6.62±0.10^{e}
Juiciness values							
Control	7.29±0.12^{e}	7.20±0.11^{d}	7.08±0.13^{c}	7.08±0.14^{c}	7.09±0.14^{c}	6.97±0.15^{b}	6.86±0.13^{a}
Treatment	7.20±0.13^{e}	7.12±0.14^{e}	7.00±0.15^{d}	7.00±0.12^{d}	6.83±0.13^{c}	6.50±0.14^{b}	6.16±0.12^{a}
Overall acceptability							
Control	7.54±0.10^{f}	7.62±0.11^{f}	7.45±0.13^{e}	7.33±0.15^{d}	7.25±0.12^{c}	7.12±0.14^{b}	7.08±0.13^{a}
Treatment	7.42±0.12^{e}	7.42±0.13^{e}	7.37±0.14^{d}	7.33±0.12^{c}	7.20±0.14^{b}	7.08±0.12^{a}	7.08±0.11^{a}

Means bearing superscripts in rows differ significantly (P ≤0.05).

meat blocks and retort processed pepper chicken, respectively during storage. The slight decrease in appearance scores might be due to low degree lipid oxidation which might facilitate the oxidation of meat pigment.

There was significant (P<0.05) difference in flavor scores for control except on 45th and 60th day of storage. On all the days, treatment sample showed slightly lower scores for flavor than control. This might be due to disliking of some panelists in nutty flavor of sesame seed. The addition of spices in the product could be reason for increased flavor scores on initial day, whose intensity might have decreased during prolonged storage. Similar trend of decrease in flavor scores over the storage period were reported by (Rajkumar *et al*., 2010; Devadason *et al*., 2014; Nalini *et al*., 2018) in retort processed goat meat curry, buffalo meat blocks and pepper chicken respectively.

Texture scores for control and treatment ranged between 6.75±0.12 to 7.66±0.12 and 6.62±0.10 to 7.37±0.13, respectively. As the storage period advanced a gradual decrease in the texture scores were recorded for both control and treatment samples. Decrease in texture scores might be due to breakdown of fat and protein and slow oxidative changes in the product Bhat *et al*. (2011) and subsequent reduction in pH, which resulted in decrease in water binding capacity during storage. Similar to the results of the present study, slight reduced texture scores were reported for various retort processed meat and chicken products namely, buffalo meat block, goat meat curry, chettinad chicken and pepper chicken by (Devadason *et al*., 2014; Rajkumar *et al*., 2010; Chandirasekaran *et al*., 2016; Nalini *et al*., 2018), respectively.

Juiciness scores for control and treatment ranged between 6.86±0.13 to 7.29±0.12 and 6.16±0.12 to 7.20±0.13, respectively. There was a gradual significant (P<0.05) decrease in juiciness scores for both control and treated samples during storage. Slight higher juiciness score in control samples might be due to addition of chevon fat. Good to very good juiciness scores might be due to fiber from sesame seed paste retained the appropriate amount of moisture and fat to assure a juicy product. Similar results were reported by (Chandirasekaran *et al*., 2016); (Nalini *et al*., 2018) in retort processed Indian type chettinad chicken product and chettinad pepper chicken respectively.

Overall acceptability scores for control and treatment ranged between 7.08±0.13 to 7.54±0.10 and 7.08±0.11 to 7.42±0.12, respectively. Both control and the 2.8% SSP treated mini chevon patties received good to very good scores (6.16±0.12 to 7.78±0.12) till 90th day of storage indicating that ambient temperature storage of retort processed product had not affected the sensory attributes during storage. There was decline in the overall acceptability scores as the storage proceeded for both control and treatment samples. Decrease in overall acceptability scores during storage might be due to the synergistic effect of declining scores of all sensory parameters or biochemical changes especially by slow oxidation in the product (Chidanandaiah, 2002). Similar slight decrease in overall acceptability scores during storage have been documented by (Rajkumar *et al*., 2010) in goat meat *curry*, (Devadason *et al*., 2014) in buffalo meat block, (Rajan *et al*., 2014) in chettinad chicken and (Nalini *et al*., 2018) in retort processed pepper chicken.

CONCLUSION

The values for TBARS, tyrosine and free fatty acids showed slow but significant (P<0.05) increase with the advancement of storage period from 0 to 90 days. The pH values decreased significantly (P<0.05) with advancement of storage period. Standard plate count, anaerobic count, Clostridium botulinum, yeast and mould counts were not detected after retort processing during the storage period. Although the sensory scores for control and treatment (2.8% SSP) decreased significantly (P<0.05) as storage progressed, scores for all the sensory parameters such as appearance, flavor, texture, juiciness and overall acceptability remained around 7.0 in eight point hedonic scale indicating good to very good sensory scores upto the end of storage study. Thus the control and 2.8% SSP treated mini chevon patties processed in indigenous retort pouches using an

indigenous retort machine would support a shelf life of 3 months at ambient temperature without appreciable depreciation in quality.

REFERENCES

AOAC (Association of Official Analytical Chemist), 1995. Official Methods of Analysis. 16th Ed, Virginia, USA.

APHA (American Public Health Association), 1984. Compendium of Methods for the Microbiological Examination of Foods, 2nd Edn, M. L., Speck. *Am. Public Health Assoc*., Washington, DC.

Bhat, Z.F., Pathak, V., Bukhari, S.A.A., Ahmad, S.R. and Bhat, H. 2011. Quality changes in Chevon Harrisa (Meat based product) during refrigerated storage. *Int. J. Meat Sci.*, **1**(1): 52-61.

Chandirasekaran, V. and Rajan. 2016. Retort processed, Indian Traditional type chettinad chicken product. *Int. J. Sci. Environ.*, **5**(4): 2395-2405.

Chidanandaiah, Sanyal, M.K. and Keshri, R.C. 2002. Changes in quality of chicken soup and chicken whey soup in laminated pouches during refrigerated storage. *J. Food Technol.*, **39**: 288-291.

Chiozzi, V., Agriopoulou, S. and Varzakas, T. 2022. Advances, applications, and comparison of thermal (pasteurization, sterilization, and aseptic packaging) against non-thermal (ultrasounds, UV radiation, ozonation, high hydrostatic pressure) technologies in food processing. *Appl. Sci.*, **12**(4): 2202.

Cyprian, O.O., Sveinsdottir, K.M.V., Nguyen, T., Tomasson, T. and Thorkelsson, S. 2017. Influence of lipid content and packaging methods on the quality of dried capelin (*Mallotus villosus*) during storage. *J. Food Sci. Technol.,* 451-458.

Devadason, P.I., Anjaneyulu, A.S.R. and Babji, Y. 2014. Quality and shelf life of buffalo meat blocks processed in retort pouches. *J. Food Sci. Technol.*, **51**(12): 3991-3997.

Dushyanthan, K., Shanmugam, A.M. and Venkataramanujam, V. 2001. Influence of vacuum packaging on certain chemical qualities of mutton. *Indian J. Anim. Sci.*, **71**: 573-576.

Elleuch, M., Besbes, S., Roiseux, O., Blecker, C. and Attia, H. 2007. Quality Characteristics of Sesame Seeds and Byproducts. *Food Chem.*, **103**: 641-650.

Francisco, M.L. and Resurreccion, A.V.A., 2008. Functional components in peanuts., *Crit. Rev. Food Sci. Nutr.*, **48**(8): 715746.

Gokhale, S.V. and Lele, S.S. 2014. Retort process modeling for Indian traditional foods. *J. Food Sci. Technol.*, **51**: 3134-3143.

Gouthamy, P.D., Manja Naik, B., Devika, G., Srinu Nayak, B., Maga Raju, S., Mohan Chitradurga, O. and Veena Shetty, A., 2021. Heat penetration characteristics and quality of ready-to-eat shrimp in masala (*Litopenaeus vannamei*) in flexible retort pouches. *J. Food Process. Preserv.*, **45**: 5.

Jeyapriya, S., Pal, U.K., Rajkumar, V., Mandal, P.K. and Kasthuri, S. 2023. Effect of sesame seed paste on the quality of mini chevon patties. *J. Meat Sci.*, **18**(1): 28 -35.

Keeton, J. 1983. Effects of fat, NaCl and phosphate levels on the chemical and sensory properties of pork patties. *J. Food Sci.*, **48**: 878-881.

Kim, J., Utama, D.T., Jeong, H.S., Barido, F.H. and Lee, S.K., 2020. Quality characteristics of retort samgyetang marinated with different levels of soy sauce and processed at different F0 values., *J. Anim. Sci. Technol.*, **62**(5): 713-729.

Konieko, E. K. 1979. Hand Book for Meat Chemists. Avery publishing Group, Inc., Wayne, New Jersey., 68-69.

Kowale, B.N., Kulkarni, V. and Kesava Rao, V. 2005. Methods in Meat Science. Jaypee Brothers Medical Publishers (P) Ltd, New Dehli., 97-98.

Lee, H.J., Hee, J.E., Hwa, L. S., Hee, K.J., Joon,. L.J. and Choi Yang-II. 2015. Effect of replacing pork fat with vegetable oils on quality properties of emulsion type pork sausages. *Korean J. Food Sci.*, **35**(1): 130-136.

Majumdar, R.K., Roy, D. and Saha, A., 2016. Textural and sensory characteristics of retort-processed freshwater prawn (*Macrobrachium rosenbergi*) in curry medium.. *Int. J. Food Prop.*, **20**:11, 2487-2498.

Morris, J.B. 2002. Food industrial nutraceutical and pharmaceutical uses of sesame genetic resources, chapter, ASHS Press, Editors: J. Janick, A. Whipkey, 153-156.

Mugale, R., Patange, S.B., Joshi, V.R., Kulkarni, C.N. and Shirdhankar, M. M. 2018. Heat penetration characteristics and shelf life of ready to serve eel curry in retort pouch. *Int. J. Curr. Microbiol. Appl. Sci.*, **7**(2): 89-100.

Nalini, P., Robinson, J.J., Abraham, V., Appa Rao, R., Narendra Babu, T. and Ilavarasan. 2015. Microbial and physicochemical qualities of retort pouch processed chettinad style chicken using desi and broiler meat. *J. Environ. Biol. Sci.*, **29**(2).

Nalini, P., Robinson, J.J., Abraham., Appa Rao, R., Narendra Babu, T., Nobal Rajkumar, R., Rajkumar, and Kathiravan, R. S. 2018. Shelf-life of Ready-to-Eat Retort Processed Pepper Chicken. *Int. J. Curr. Microbiol. Appl. Sci.,* **7**(3): 832-840.

Pearson, D. 1968. Application of chemical methods for assessment of beef quality. III. Methods related to fat spoilage. *J. Sci. Food Agric.*, **19**: 553-556.

Praharasti, A.S., Kusumaningrum, A., Khasanah, Y., Nurhayati, R., Nurhikmat, A., Susanto, A. and Suprapedi. 2019.

Physicochemical properties and its relations of beef rendang inside retort pouch packaging in various temperature storage conditions. *IOP Conf. Ser. Earth Environ. Sci*., **251**(1): 012043.

Priyanka, V.S. 2017. Quality attributes and shelf life evaluation of retort processed cereal based chicken stew. M.V.SC thesis submitted to Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar.

Rajan, S., Kulkarni, V.V. and Chandirasekaran, V. 2014. Preparation and storage stability of retort processed Chettinad chicken. *J. Food Sci. Technol.,* **51**: 173-177.

Shagufta, I., Khan, N., Siddiqui, M.A., Siddiqi, R. 2013. Antioxidant potential of the extracts fractions and oils derived from oilseeds. *Food Sci.,* **2**(4): 246-256.

Snedecor, G.W. and Cochran, W.G. 1994. *Statistical methods. The Iowa state University Press, Iowa.*

Sreelakshmi, K.R., Manjusha, L., Nagalakshmi, K., Chouksey, M.K., Venkateshwarlu, G. 2015. Ready to serve crab sandwich spread in retort pouch: Product development and process optimization. *J. Aquat. Food Prod. Technol*., **4**(24): 315-329.

Strange, E.D., Benedict, R.C., Smith, J.C. and Swift, C.E. 1977. Evaluation of rapid tests for monitoring alterations in meat during storage. *Int. Meat J. Food Prot.*, **40**: 843.

Tarladgis, B.G., Watts, B.M., Younathan, M.T. and Dugan, L.R. 1960. A distillation method for the quantitative determination of malanoldehyde in rancid foods. *J. Am. Oil Chem. Soc.*, **37**: 44.

Tribuzi, G., Aragoa, G.M.F.D. and Laurindo, J.B. 2015. Processing of chopped mussel meat in retort pouch. *Food Sci. Technol.*, **35**: 612-619.

Vijitpunyaruk, T. 2022. The Development of Palmyra Sugar Caramel Sauce Product in Retortable Pouch. *Burapha Sci. J.*, 151-170.

Watts, B. M. 1962. Meat products. Symposium on food lipids and their oxidation. Westport, CT:AVI Pub. Co. Inc, 202.

Yamagushi, K. 1990. Retortable packaging. *In:* Kadoya T.(Ed) Food packaging Academic Press, Inc, New York., 185-211.

Zipser, M.W. and Watts, B.M. 1961. Lipid oxidation in heat-sterilized beef. *Food Technol.*, **15**: 445.