International Journal of Agricultural Science and Research (IJASR)
ISSN (P): 2250-0057; ISSN (E): 2321-0087
Vol. 12, Issue 2, Dec 2022, 31-40

QUALITY EVALUATION OF READY-TO-EAT CASHEW NUT CURRY UNDER FROZEN STORAGE

AMALI RAJAPAKSHA[1] & DHANESH LIYANAGE[2]

[1]*Research Scholar, Department of Food Science and Technology, Wayamba University of Sri Lanka, Sri Lanka*

[2]*Senior Lecturer, Department of Food Science and Technology, Wayamba University of Sri Lanka, Sri Lanka*

ABSTRACT

Cashew nut curry is a popular traditional Sri Lankan dish. This study was conducted to develop and evaluate the quality of a ready-to-eat cashew nut curry stored under frozen storage. The curry was prepared in the traditional Sri Lankan method and packed in high density polyethylene (HDPE) and metalized polyethylene (MP) vacuum pouches separately, and stored at -18°C for 3 months. Samples were drawn and tested for proximate analysis, peroxide value, free fatty acid value, pH value, antioxidant scavenging activity, viscosity of gravy, microbial and sensory qualities. During three month frozen storage, the peroxide values (PV) increased from 0.365 to 3.425 mEq O_2/kg for cashew nut curry packaged in HDPE pouch and to 2.469 mEq O_2/kg for cashew nut curry packaged in MP pouch. A marginal decreases in antioxidant scavenging activity percentage values (29.45–19.09) for HDPE pouch and (29.45–20.36) for MP pouch were also observed during 3 month storage. Values for free fatty acid (0.42 and 0.40 as a percentage of oleic acid) pH (5.73 and 5.80) and viscosity values of gravy (9.1 and 8.8 Pas) were not significantly different among the samples stored in HDPE and MP pouches at the end of 3 month storage. During storage, the total plate count (TPC) and yeast and mold count were found to be decreasing over period of storage in both packages (<10^1 for TPC and <10^0 for yeast and mold) indicating that the product was microbiologically safe. Sensory scores indicated that the cashew nut curry stored under both packages were within acceptable limits for 3 months under -18°C storage. The best overall protection and quality of the product was highest in the samples packed in metalized polyethylene vacuum pouches.

KEYWORDS: Cashew Nut Curry, Frozen Storage, Packaging, Peroxide Value, Antioxidant Scavenging Activity

Received: Sep 22, 2022; Accepted: Oct 11, 2022; Published: Oct 25, 2022; Paper Id: IJASRDEC20225

Original Article

INTRODUCTION

Sri Lankan cashew nut (*Anacardium occidentale* L.) has assumed greater importance due to its special qualities and unique taste. There is a high tendency in the world toward purchasing processed foods due to the convenience to consumers. The Food Processing Industry in Sri Lanka is one of the emerging and lucrative industries in terms of production, consumption, export and growth prospects (BOI, 2022). Therefore, there are more opportunities created for value added food products in the market for the local manufacturers, since people trend to consume processed food products.

Cashew nut curry is one of the famous curries in Sri Lanka as a delicious traditional dish as well as an essential item in the menu in every special occasion. Preparation of cashew nut curry is time consuming and needs few unit operations, therefore ready-to-eat product provides value addition to raw cashew and provide convenience to consumers.

Quality and safety of processed food is a major concern of both consumers and manufacturers. Therefore, this study aimed development of ready-to-eat cashew nut curry and test physico-chemical, microbiological and organoleptic quality of the cashew nut curry stored in different packaging material under frozen conditions.

METHODOLOGY

Samples Preparation

The raw cashew nuts and other ingredients purchased from the local retail shops were used as ingredients. Cashew curry was prepared in traditional way (soaking for 9 hours with 1% sodium bicarbonate solution) with a milk gravy using coconut milk, red onion, garlic, green chili, curry leaves, rampe, turmeric powder, fenugreek, cinnamon and salt. Upon organoleptic evaluations, most acceptable standard procedure to the curry preparation was selected for sample preparation. Cooked cashew nut curry samples were allowed to cool for 40^{o}C and 100 g portions (cashew nut:gravy = 3:1) were packed in high density polyethylene (HDPE) and metalized polyethylene (MP) pouches using vacuum packaging technique. Samples were stored at -18^{o}C for three months for the analysis of physico-chemical, microbial and organoleptic characteristics. Physico-chemical and microbial tests were carried out biweekly in triplicates for the frozen samples.

Proximate Analysis

Crude fat, crude protein, crude fiber and total ash values of the samples were determined by performing Soxhlet method, Kjeldahl method, gravimetric method after digestion with sulfuric acid and ignition by muffle furnace, respectively.

Physico-Chemical Parameter Evaluation

Moisture content of the samples were determined by oven drying method. Peroxide values were determined by iodometric method (Gutfinger et al., 1976). Free fatty acid values were determined by titrametric method. pH values of the samples were measured using pH meter method. Antioxidant scavenging activity was measured by using spectrophotometic method using methanoic DPPH solution (Badami et al., 2005). Viscosity of the gravy was measured using Ostwald capillary viscometer method (Bames et al., 1989).

Microbial Quality Evaluation

Total plate counts (TPC) were determined using plate count agar, presence of coliforms were determined using Mac-Conkey broth upon incubation, yeast and mould counts were determined using tempered yeast and mold agar.

Sensory Evaluation

The sensory evaluations were conducted by 30 semi-trained panelists. Packets of frozen cashew curry were thawed by holding them at 25 ± 2°C for 15 minutes and microwaving for 1 minute. Simple ranking test and nine point hedonic scales (ASTM 1996; Modi et al., 2003) for five attributes (color, gravy consistency, texture of cashews, flavor and overall acceptability) were carried out for sensory evaluations.

Statistical Analysis

The statistical analysis was performed using the Minitab software. The physico-chemical data was analyzed using one way analysis of variance (ANOVA) and two sample t-test with confidence interval of 95% and criterion for statistical significance was $p<0.05$. The sensory data was analyzed using Friedman test with confidence interval of 95%.

RESULTS

Proximate Analysis of Cashew Nut Curry

Proximate analysis of the cashew nut curry revealed that it contained 66.6% moisture, 22.9% crude fat, 6.3% carbohydrates (1.7% crude fiber), 2.2% crude protein and 2.0% ash.

Microwaving Time of Cashew Nut Curry

Frozen cashew nut curry microwaved at medium temperature for 60 seconds had highest scores for overall acceptability (appearance, gravy consistency, flavor and cashew nut texture, $p<0.05$) over 30 and 90 seconds microwaved time periods.

Variation of Moisture Content

Moisture content in cashew nuts increased ($p<0.05$) during first two weeks while reducing ($p<0.05$) moisture content in the gravy, resulting in higher viscosity. Overall moisture content in cashew nut curry remained constant over the storage period. No differences were observed in moisture contents ($p>0.05$) between the cashew nut samples packed in HDPE pouches or MP pouches. Variation of moisture content of cashew nuts and gravy stored in different packaging material is shown in Figure 1.

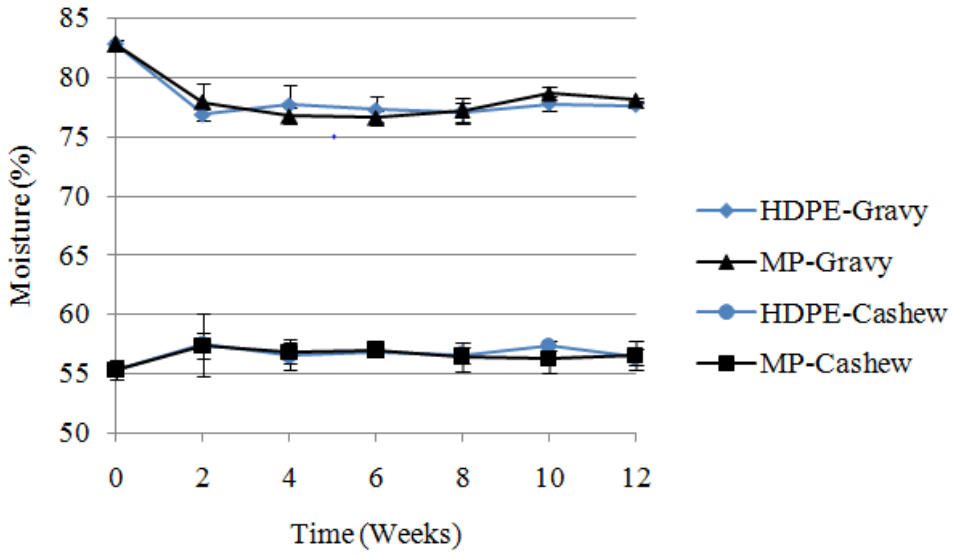

Figure 1: Variation of Moisture Content of Cashew Curry in Different Packages (HDPE- High Density Polyethylene, MP- Metalized Polyethylene)

Variation of Peroxide Value

The peroxide value of the samples packed in HDPE and MP increased gradually over storage period. The peroxide value of the cashew curry packed in HDPE pouch was significantly higher compared to the MP pouch ($p<0.05$) throughout the storage period (2^{nd} week to 12^{th} week). Variation of peroxide value of cashew nuts curry stored in different packaging material is shown in Figure 2.

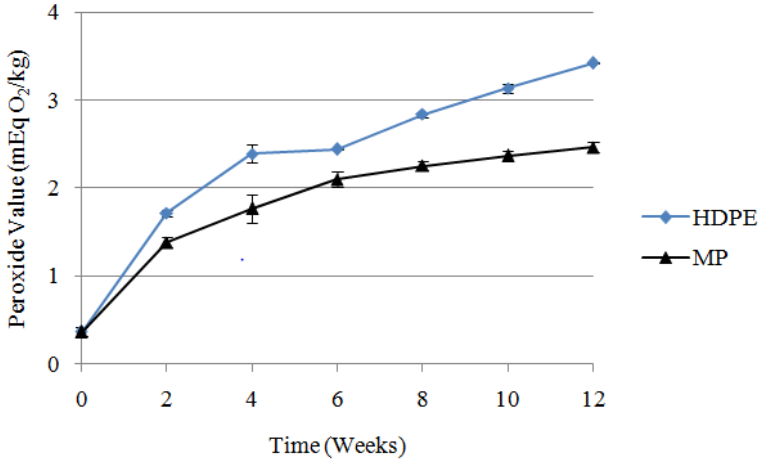

Figure 2: Variation of Peroxide Value of Cashew Curry in Different Packages (HDPE- High Density Polyethylene, MP- Metalized Polyethylene)

Variation of Free Fatty Acid Value

Free fatty acid (FFA) values of samples showed increase in FFA value over storage period, but the FFA values packed in HDPE and MP pouches were not significantly different ($p>0.05$). Variation of FFA values of cashew nut curry stored in different packaging material is shown in Figure 3.

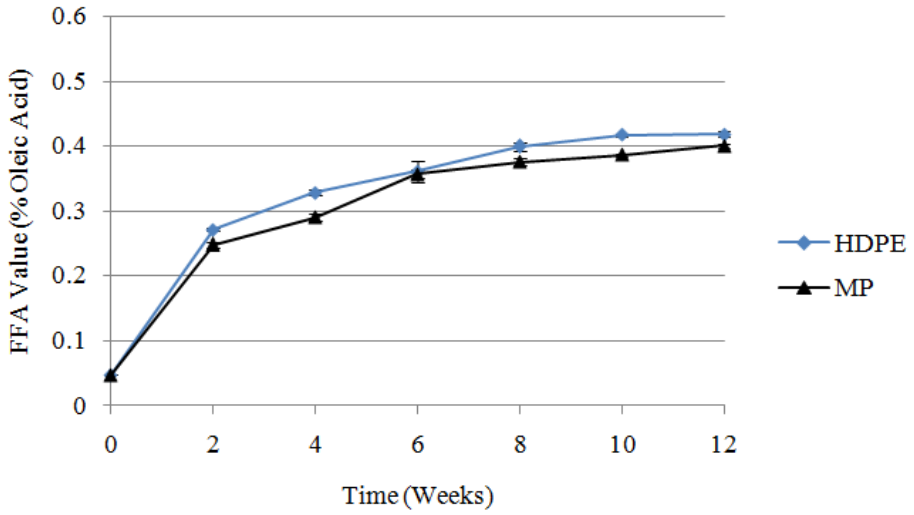

Figure 3: Variation of Free Fatty Acid Value of Cashew Curry in Different Packages(HDPE- High Density Polyethylene, MP- Metalized Polyethylene)

Variation of PH Value

pH values of the whole product and gravy of samples packed in both pouches significantly decreased during the storage time. No significant differences were observed in pH values between samples packed in HDPE and MP pouches ($p>0.05$). Variation of pH values of cashew nut curry gravy over the storage time is shown in Figure 4.

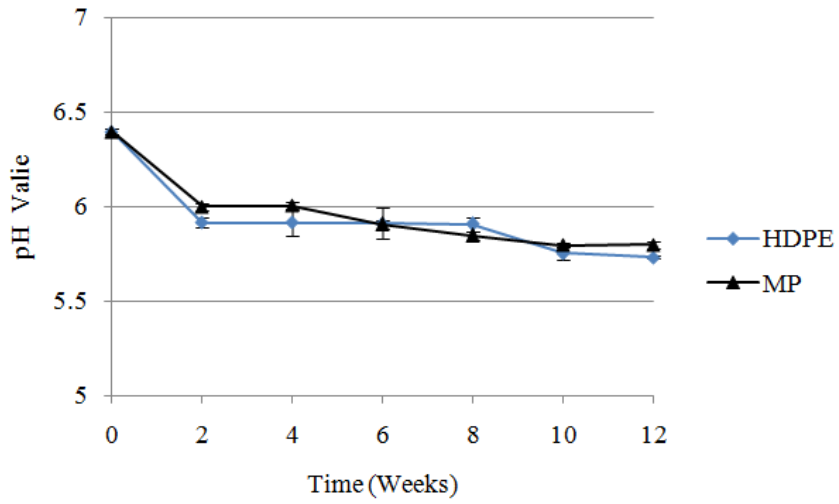

Figure 4: Variation of Ph Value of Cashew Curry in Different Packages (HDPE- High Density Polyethylene, MP- Metalized Polyethylene)

Variation of Antioxidant Scavenging Activity

The remaining natural antioxidant scavenging activity in the both treatments were reduced gradually over the storage time in the cashew curry samples packed in both HDPE and MP packages. Significantly lower natural antioxidant scavenging activity values ($p<0.05$) were observed in cashew nut curry packed in HDPE pouches during 8 week onward compared to MP pouches. Variation of antioxidant scavenging activity values of cashew nut curry gravy over the storage time is shown in Figure 5.

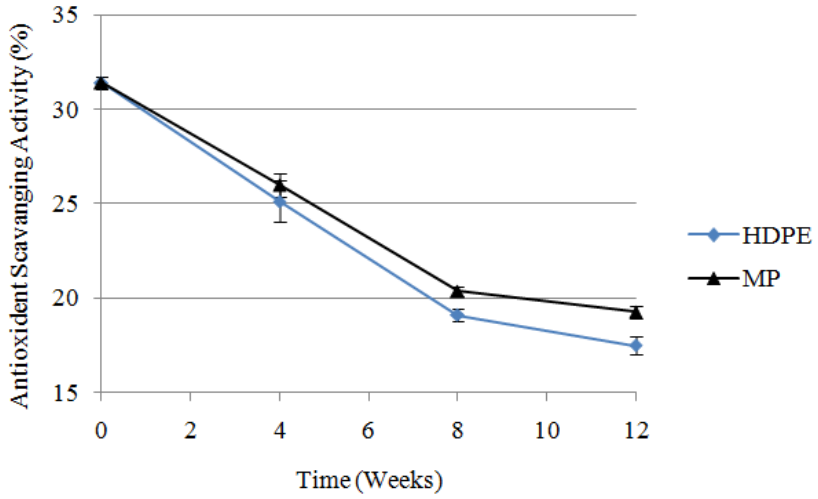

Figure 5: Variation of Antioxidant Scavenging Activity of Cashew Curry in Different Packages (HDPE- High Density Polyethylene, MP- Metalized Polyethylene)

Variation of Viscosity of the Gravy

Cashew nut curry gravy had lower viscosity value (6.859 Pas) and it increased over the time in both HDPE pouches (9.110 Pas) and MP pouches (8.839 Pas). However, viscosity of gravy in the both treatments did not vary significantly ($p>0.05$). Variation of viscosity values of cashew nut curry gravy over the storage time is shown in Figure 6.

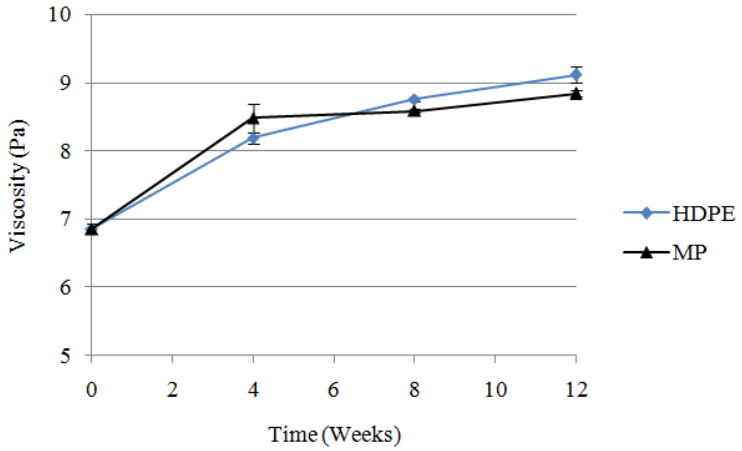

Figure 6: Variation of Viscosity of Cashew Curry Gravy in Different Packages (HDPE- High Density Polyethylene, MP- Metalized Polyethylene)

Variation of Total Plate Count

The total plate count readings showed the highest count at initial stage and it reduced over the storage period (Table 1). Coliforms were not detected in any of the samples.

Table 1: Variation of TPC (CFU/g) of Cashew Nut Curry during Storage

Treatment/Week	0	2	4	6	8	10	12
HDPE	$1.93\times10^{2\,a}$	$7.60\times10^{1\,b}$	$7.33\times10^{1\,b}$	$2.00\times10^{1\,c}$	$1.00\times10^{1\,c}$	$3.33\times10^{0\,c}$	$3.33\times10^{0\,c}$
MP	$1.93\times10^{2\,a}$	$1.16\times10^{2\,a}$	$7.33\times10^{1\,b}$	$5.33\times10^{1\,c}$	$2.00\times10^{1\,cd}$	$1.00\times10^{1\,d}$	$6.67\times10^{0\,d}$

The mean values with different superscripts in same treatment differ significantly ($p\leq 0.05$)

Variation of Yeast and Mold Count

Yeast and mold were detected in both samples at the initial stage; however they were not detected in both type of pouches (Table 2) at the end of 3 month period.

Table 2: Variation of Yeast and Mold (CFU/g) of Cashew Nut Curry during Storage

Treatment/week	0	2	4	6	8	10	12
HDPE	6.67×10^{1}	3.33×10^{1}	3.33×10^{1}	ND	ND	ND	ND
MP	6.67×10^{1}	3.33×10^{1}	ND	ND	ND	ND	ND

(ND=Not detected)

Variation of Sensory Characteristics

Both samples packed in HDPE pouches and MP pouches did not differ sensory attributes (flavor, color, cashew nut texture, gravy consistency and overall acceptability) at 3 month storage. Freshly prepared cashew nut curry samples had higher values ($p<0.05$) for the color over samples packed in HDPE and MP pouches, however texture, gravy consistency and overall acceptability of samples packed in HDPE and MP pouches were superior in quality values ($p<0.05$) compared to freshly prepared samples.

DISCUSSION

Water absorption increase with an increase of soaking time in accordance with the previous studies (Chopra and Prasad,

1994). The cashew nut sample which soaked for 9 hours, achieved the highest average rank for overall acceptability. With the increase of soaking time, development of unpleasant taste and odors are evident. However, an initial soaking is needed to reduce the cooking time and to improve the appearance of processed nuts. It is reported that the water absorption during soaking could improve the extent of protein denaturalization and supplies adequate moisture content for further cooking operations (Bayram et al., 2003). Therefore, the water absorption is directly related to the changes in textural characteristics and properties of nuts. However, soaking could lead to some loss of soluble solids. Soaking operation prior to cooking helps to eliminate the toxic factors contained in the raw nuts (Bayram et al., 2003).

Results showed that the cashew nut had increased moisture over time and gravy had reduced the moisture. Having constant moisture levels in the samples throughout the storage period depicts that the moisture changes were within the matrix only, as the HDPE and MP has superior barrier properties to moisture (Henríquez, 2013). The moisture increments in the cashew nut resulted soft texture in cashew nuts and lowering the moisture in gravy resulted higher consistency in the gravy. The increased viscosity in the gravy may also be due to the soluble solid migration from the cashew nuts to the gravy.

Cashew consists of higher contents of fat, which could lead to rancidity development. Peroxide value is an indication of fat oxidation that could lead to rancidity. The observed peroxide values indicate that there is a significant increment in peroxide values of the HDPE treatment compared to samples which were packed in metalized polyethylene pouches. This indicates that packaging material has an effect on oxidative rancidity, and it can be effectively controlled by using a metalized vacuum pouch under freezing and vacuum conditions. The spices which were used for preparation of the curry exhibit their natural anti-oxidative properties and reduce the rate of oxidation in this product. The remaining natural antioxidant content of the whole product has gradually decreased over the storage time in the both treatments. Therefore, it is evident that the natural antioxidants have been involved in the anti-oxidative reactions and it has been consumed over time. However, both treatments showed lower peroxide values when compared to the maximum reference value of oxidative rancidity (10 mEq O_2/kg). This study revealed that both HDPE and MP pouches can be used to pack cashew nut curry for three months under frozen storage without development of rancidity.

The free fatty acid (FFA) content was increased over time without having significant differences between the cashew nut samples stored in both HDPE and MP pouches. Further, results showed reduction in pH value of the curry, which is in line with FFA values. The possible reason for the increment of free fatty acid value could be due to the relatively higher amount of moisture content in the product as well as the lipase activity of the added raw materials that activated the hydrolytic rancidity. Another reason for the above effect would have been type of fat, unsaturated fats, coming from coconut milk and cashew nuts. The higher amounts of unsaturated fat content may have lead to a higher value of free fatty acids content.

The moisture contents of all the treatments remain constant with small fluctuations over the storage time. This indicates that there was no moisture migration through the packaging during the storage period. However, the results showed that a significant increment of moisture content in cashew nuts and a significant reduction in the gravy of the product during first two weeks in the both treatments, indicating moisture migration from the gravy to the cashew nuts. Therefore moisture migration is affected to the increment of viscosity of the gravy during frozen storage. The results obtained for moisture migration are similar to the results obtained in the previous studies related to frozen products. They have also shown moisture migration is the principal physical change occurring in frozen foods, affecting the physical,

chemical, and biochemical properties, including texture and palatability of the food (Pham and Mawson, 1997).

Low initial counts of bacteria and, yeasts and molds in the product could be due to thermal processing, hygienic practices followed during processing and anti-microbial effects of spices (Grohs et al., 2000). Over the storage period the yeast and mold counts and total plate count gradually decreased in both treatments. The product did not have the favorable conditions for the growth of yeasts and molds. Insufficient oxygen content and frozen temperatures restricted the growth of yeast and molds as well as the total plate counts. Results showed cashew nut curry stored in HDPE and MP pouches were microbiologically safe for minimum of three months at frozen storage.

There was no significant difference between two treatments along with the storage period in each attribute of sensory quality. However, freezing caused to increase acceptability for cashew nut texture and consistency of gravy than the freshly prepared curry. During freezing ice crystal formation results expansion of the cell content which caused cell wall rupture. Consequently, the texture of the product is generally much softer after thawing with compared to non-frozen produce (Schafer and Munson, 1990). On the other hand, due to the fatty acid increment of the product as well as the moisture reduction of gravy, yellow color of the product gets prominent with the frozen storage. However, in the present investigation, seasonal oxidized flavor was not detected even when peroxide values were around 3 mEq O_2/kg. This could be due to the masking effect of the flavor with spices. In the current investigation, the both cashew nut curry product are sensorially acceptable (scores >7.0) even after storage for 3 months at -18^{o}C.

In the frozen storage, most of the milk curries are subjected to separates easily, therefore, they needed to be stirred and heated after defrosting. Cashew nut curry which is microwaved at medium temperature for 1 minute gave highest score for overall acceptability by considering appearance, gravy consistency, flavor and cashew nut texture. With the increased microwaving time, curdle formation can be observed in the gravy that leads to reduced consumer acceptability. Further, longer microwaving period results reduction in the water content of gravy causing dryness in curry.

CONCLUSIONS

Cashew nut curry packed in the metalized vacuum pouch had superior storage condition over high density polyethylene pouch. The product quality as determined by moisture content, viscosity of gravy, pH value, rancidity parameters, microbiological and sensory parameters indicate that the cashew nut curry can be stored in -18 ^{o}C for 3 months without marked loss in quality.

REFERENCES

1. *ASTM. 1996. American Society for Testing Materials. Manual Series MNL 26, 2nd Ed., American Society for Testing and Materials, Philadelphia, PA.*
2. *Badami, S., Dongre, S.H., and Suresh, B., 2005. In vitro antioxidant properties of Solanum pseudocapsicum leaf extracts. Indian J. Pharmacology. 37(4), Pp. 251-252.*
3. *Bames, H.A., Hutton, J.F. and Walters, K., 1989. An Introduction to Rheology, Chapter 2, Elsevier.*
4. *Bayram, M., Kaya, A. and Öner, M.D., 2003. Water absorption, leaching and color changes during the soaking for production of soy bulgur. J Food Process Eng. 27, Pp. 119-141.*
5. *BOI, 2022. Board of Investment of Sri Lanka: Food Processing. Available at <https://investsrilanka.com/food-processing-new/> [Accessed 10 October 2022]*

6. *Chopra, R. and Prasad, D.N., 1994. Standardization of soaking conditions for soybean seeds/ cotyledons for improved quality of soymilk. Indian J Anim Sci. 64: Pp. 405-410.*
7. *Grohs, B.M., Kliegel, N. and Kunz, B., 2000. Bacteria grow slower: Effects of spice mixtures on extension of shelf life of pork. Fleischwirtschaft. 80(9), Pp. 61–63.*
8. *Gutfinger, T., Peled, M., and Letan, A. 1976. Iodometric Determination of the Peroxide Value of Edible Oils, Journal of Association of Official Analytical Chemists, Volume 59(1) Pp 148–152.*
9. *Henríquez, C., Córdova, A., Lutz, M. and Saavedra, J., 2013. Storage stability test of apple peel powder using two packaging materials: High-density polyethylene and metalized films of high barrier. Industrial Crops and Products. 45, Pp 121-127,*
10. *Modi, V.K., Mahendrakar, N.S., Narasimha Rao, D. and Sachindra, N.M., 2003. Quality of buffalo meat burger containing legume flours as binders. Meat Sci. 66, Pp. 143–149.*
11. *Pham, Q.T. and Mawson, R.F., 1997. Moisture migration and ice recrystallization in frozen foods. In: Erickson, M. C., Hung, Y., (Eds) Quality in Frozen Foods, Chapmann and Hall, New York.*
12. *Schafer, W. and Munson, S.T., 1990. Freezing of fruits and vegetables. Extension service of university of Minnesota.*
13. *Dincheva, Ivayla, and Ilian Badjakov. "Assesment of the anthocyanin variation in bulgarian bilberry (Vaccinium myrtillus L.) and lingonberry (Vaccinium vitis-idaea L.)." International Journal of Medicine and Pharmaceutical Science (IJMPS) ISSN (P) (2016): 2250-0049.*
14. *Deepa, J., P. Rajkumar, and Thangaraj Arumuganathan. "Quality analysis of copra dried at different drying air temperatures." International Journal of Agricultural Science and Research (IJASR) 5.4 (2015): 1-5.*
15. *Sirlene, M., Et Al. "Textile Fiber Produced From Sugarcane Bagasse Cellulose: An Agro-Industrial Residue." Transstellar Journal Publication And Research Consultancy–Tjprc (2013).*
16. *Ghania, Iazzourene, Mouhouche Fazia, And Hazzit Mohamed. "Antioxydant And Insecticidal Activity Of Algerian Myrtus Communis L. Extracts." International Journal Of Agricultural Science And Research (Ijasr) 4.6 (2014): 193-201.*
17. *Borkataky, Munmi, And Sood Kaushal. "Antibacterial, Antioxidant And Cytotoxic Activities Of Cinnamomum Tamala Nees. Leaves." International Journal Of Medicine And Pharmaceutical Sciences 4.6 (2014): 55-62.*
18. *Ghania, Iazzourene, Mouhouche Fazia, And Hazzit Mohamed. "Antioxydant And Insecticidal Activity Of Algerian Myrtus Communis L. Extracts." International Journal Of Agricultural Science And Research (Ijasr) 4.6 (2014): 193-201.*