Original Research

Development and Quality Evaluation of Ready-To- Eat Chicken Snacks Incorporated with Finger Millet (*Eleusine coracana*) on Storage at Ambient Temperature

Shelcy S. Akkara*, Renuka Nayar, N. Manjunath, Sunanda C.[1] and Kavitha Rajagopal

Department of Livestock Products Technology, College of Veterinary and Animal Sciences, Pookode, Wayanad-673 576, Kerala, INDIA

[1]Department of Statistics

***Corresponding author:** shelcyakkara2328@gmail.com

Rec. Date:	Aug 21, 2019 05:45
Accept Date:	Sep 19, 2019 18:35
DOI	10.5455/ijlr.20190821054551

Abstract

Current study was intended for the development of ready to eat chicken snacks incorporating finger millet flour, which could be stored at ambient temperature. Snacks containing 50 % chicken and 46.5 % finger millet flour and subjected to modified atmosphere packaging (MAP) were compared with control snacks without meat for physico-chemical, textural, microbiological and sensory attributes on days 0, 15, 30, 45, 60, 75 and 90 of ambient temperature storage. No spoilage was detected till 90 days in control and treatment snacks. pH and total phenolics were significantly ($p<0.05$) higher for treatment snack. Control group had higher colour and hardness values. Based on sensory evaluation and other physico- chemical analysis, it was concluded that chicken snacks containing finger millet could effectively be stored up to 90 days under ambient temperature with acceptable sensory attributes.

Key words: Ambient Temperature Storage**,** Chicken Snacks, Finger Millet, Modified Atmospheric Packaging, Ready-To-Eat

How to cite: Akkara, S., Nayar, R., Manjunath, N., Sunanda, C., & Rajagopal, K. (2019). Development and Quality evaluation of Ready-to-Eat Chicken Snacks Incorporated with Finger Millet (*Eleusine coracana*) on Storage at Ambient Temperature. *International Journal of Livestock Research*, *9*(11), 65-74. doi: 10.5455/ijlr.20190821054551

Introduction

Health and dietary preferences are interrelated and hence people are more concerned about the products they are consuming. To maintain a healthy lifestyle, modern day consumers prefer foods with adequate amount of nutrients. Muscle foods are rich sources of proteins, iron with high bioavailability and B complex vitamins. In India, among all meats, chicken is most favoured due to dietary preferences like high palatability, flavour and taste, lower price and absence of cultural and religious issues.

Snacks are products that require less or no preparation, are easy to handle and satisfy the intermittent hunger (Kumar *et al.*, 2019). Most of the snacks available in the market are cereal based and they have high calorie and low protein. Nutritive value of these snacks can be modified by incorporating animal products such as meat. Meat snacks have high nutritive value and contain good quality protein with all essential amino acids and have improved organoleptic properties such as flavour and taste (Raja *et al*., 2014). Notwithstanding the fact that meat is rich in almost all nutrients, it lacks dietary fibre and antioxidant activity. Dietary fibre and phytochemicals possesses antioxidant and antimicrobial properties and thus impart beneficial effects on the health of the consumer (Jones and Engleson, 2010). Studies have revealed that regular consumption of whole grain cereals and their products can protect against the risk of cardiovascular diseases, type II diabetes, gastrointestinal cancers and a range of other disorders (McKeown, 2002). Finger millet (*ragi*) is cultivated extensively in India and our country stands sixth in its production. It is widely used in the preparation of traditional foods, such as *roti* (unleavened breads or pancake), *mudde* (dumpling) and *ambali* (thin porridge) (Devi *et al*., 2014). It is rich in dietary fibre, calcium and iron. In addition to increasing their fibre content, dietary fibres also accord other beneficial effects such as fat replacement, increased water-holding capacity and improved oxidative stability to meat products (Choi *et al*., 2008). A study was conducted to develop ready-to-eat chicken snacks by incorporating finger millet and to compare their physico- chemical, textural, microbiological and sensory attributes with control snacks. Both the treatment and control shacks were packed under modified atmosphere and the snacks were stored at ambient temperature.

Materials and Methods

Broiler chicken were procured from the local markets in Vythiri, Wayanad district and were brought to the department of Livestock Products Technology, College of Veterinary and Animal Sciences, Pookode. The birds were provided *adlibitum* water and proper rest. They were slaughtered, dressed under hygienic conditions and the carcasses were washed and chilled overnight ($4 \pm 1\ ^0C$). On the next day chilled carcasses were cooked, deboned, minced and used for the preparation of snacks.

Preparation of Snacks

The control and treatment snacks were prepared using the ingredients in Table 1. The carcasses were pressure cooked for 15 min, allowed to drain and deboned. The deboned meat was minced twice through 4.5 mm diameter grinder plate in a meat mincer (Sirman, Italy). Rice, Bengal gram and finger millet flours were purchased from the local market. The dough was made using finely minced meat, flours, spice mix, salt, chili powder and asafoetida powder. The ingredients were mixed thoroughly in a planetary mixer (Italiya, Sahiya Trading Company, Ernakulam) after adding lukewarm water. Dough for control and

 DOI 10.5455/ijlr.20190821054551

treatment group were prepared separately. Control was prepared with the three flours in equal proportions without incorporating meat. The prepared dough of control and treatment group were extruded through a manually operated stainless steel extruder into thin ribbon shaped forms and fried in an electric deep fat fryer (DF-81, Electric fryer), for 3.30 and 2.30 min, respectively for control and treatment snacks at temperature 140 ^{0}C. The snacks were cooled to ambient temperature, and were subsequently subjected to modified atmosphere packaging (Sevana, Quick seal- QS400VS3G, Kochi) with N_2 as flushing gas (pressure 200 mmHg, sealing time 1.5 sec, cooling time 8 sec) using laminated polyethylene-polyester pouches.

Table 1: Formulations of control and treatment snacks

Ingredients	Control snack (%)	Treatment snack (%)
Minced meat	Nil	50
Rice flour	32.17	Nil
Bengal gram flour	32.17	Nil
Finger millet flour	32.17	46.5
Salt	1	1
Chilli powder	2	2
Spice mix	0.25	0.25
Asafoetida	0.25	0.25

The snacks were subjected to analysis of physico-chemical characteristics such as pH (AOAC, 2016), thiobarbituric acid reactive substance (TBARS) numbers (Witte *et al.*, 1970), tyrosine value (Pearson, 1968), total phenolics (Escarpa and Gonzalez, 2001) , microbiological parameters such as aerobic plate count (APC) (Morton, 2001) and yeast and mould count (YMC) (Beuchat and Cousin, 2001), analysis of moisture content (AOAC, 2016) and sensory evaluation (Badr *et al*., 2004) on days 0, 15, 30, 45 60, 75 and 90 days of storage. The samples were also analysed for L* a* b* colour values (Page *et al*., 2001) and texture profile analysis (Bourne 1978) on days 0, 15, 30, 45 60 of storage. Frying loss, protein content, fat content, dietary fibre content and ash content were analysed on the day of preparation only.

Statistical Analysis

The data obtained were statistically analyzed by independent t-test, repeated measures ANOVA, Kruskal-Wallis test, Wilcoxon signed rank test, Friedman test, Mann Whitney test using SPSS software (VERSION 21) as per Snedecor and Cochran (1994).

Results and Discussion

Frying Loss

Significantly ($p<0.01$) higher frying loss was noticed in treatment snack (38.42 ± 0.86 %) when compared to control (33.10 ± 0.92 %) due to the addition of meat. Observed results were in accordance with Talukder

DOI 10.5455/ijlr.20190821054551

et al. (2015) who obtained lowest cooking loss for control groups with flours only when compared to snacks containing mutton and flours.

pH

pH of control and treatment snacks varied significantly ($p< 0.01$), with higher pH in treatment snack, due to incorporation of meat. pH values decreased significantly till 30th day in both samples and on day 90, pH values were significantly higher than those on day 0. Increased pH during storage was reported by Jose (2012) in dehydrated chicken shreds and it could be due to proteolysis.

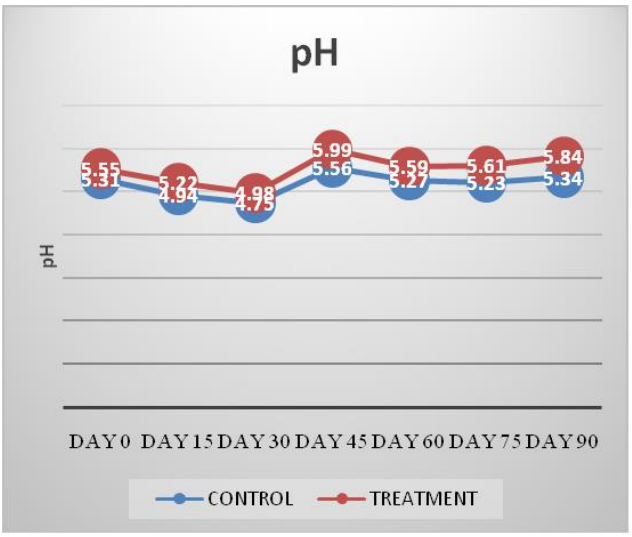

Fig. 1: pH values of control and treatment snacks on different storage days

Thiobarbituric Acid Reactive Substances (TBARS) Number

The variation in the TBARS values of control and treatment snacks were found to be highly significant ($p<0.01$) on all days of storage except days 15, 30 and 45. Treatment snack had higher TBARS values, due to the presence of meat. An increase in the values was noticed in both snacks on day 90 when compared to day 0 and might be due to increased lipid oxidation on storage. In contrast with this, Pavan *et al.* (2018) reported a decrease in TBARS numbers in finger millet added chicken nuggets during storage due to the antioxidant property of the flour.

DOI 10.5455/ijlr.20190821054551

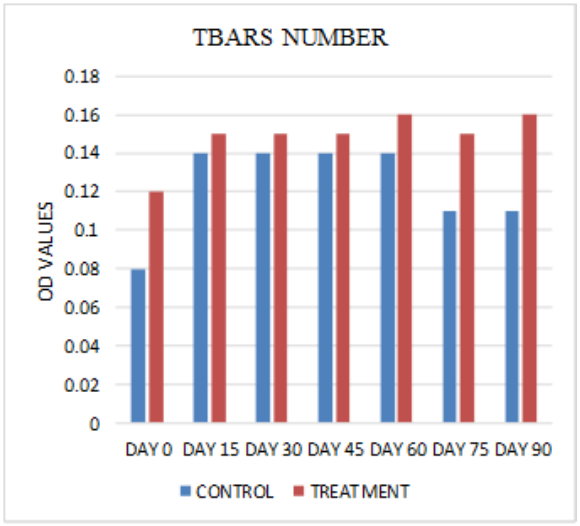

Fig. 2: TBARS numbers of control and treatment snacks on different storage days

Tyrosine Values

Significantly ($p<0.01$) lower tyrosine value was observed in the control than treatment snack on all days of storage and it might be due to the absence of meat in control snack. There was a decline in tyrosine value till 30 days in case of the treatment, till 45 days in case of control, and the tyrosine value began to rise thereafter. In both samples tyrosine values of day 90 were significantly higher than those on day 0. Thomas *et al*. (2008) reported increased tyrosine values during storage due to proteolysis and increased bacterial load.

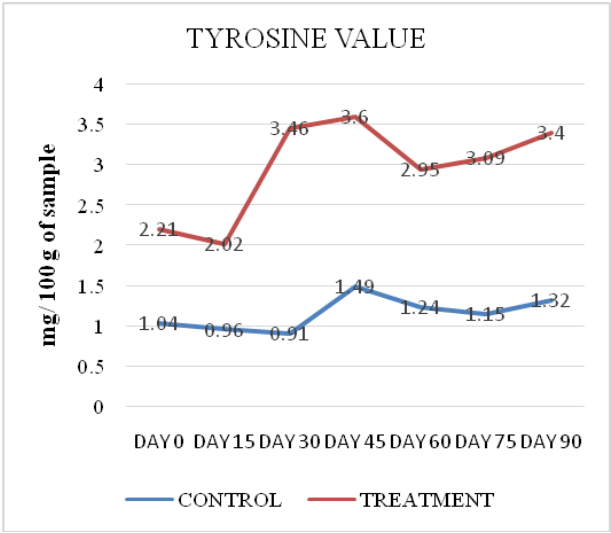

Fig. 3: Tyrosine values of control and treatment snacks on different storage days

DOI 10.5455/ijlr.20190821054551

Total Phenolics

Treatment snack exhibited significantly ($p< 0.01$) higher total phenolic content than control on all days of storage. Large amount of phenolics in the finger millet might have resulted in the higher phenolic content of the product. Devi *et al*. (2014) observed a total phenolic content of 7.3 g/100g in finger millet flour. Phenolic content is an indicator of anti-oxidant ability of the product and it was found to constantly decrease on storage in both samples.

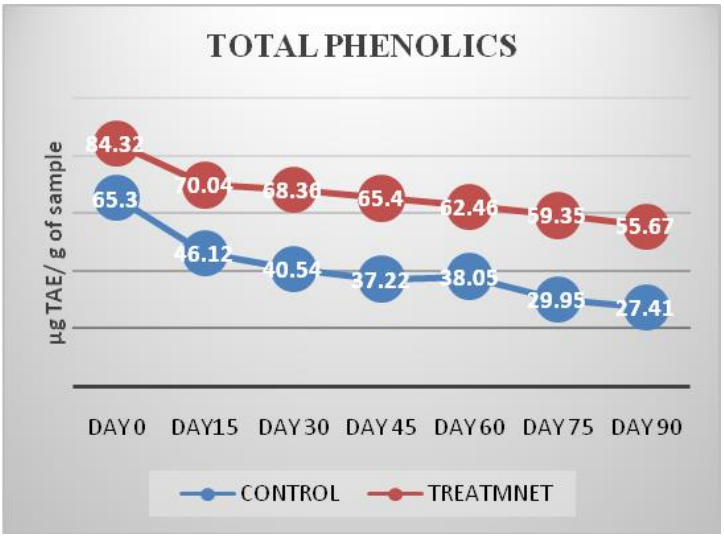

Fig. 4: Total phenolics of control and treatment snacks on different storage days

L* a* b* Colour Values

Lightness (L*), redness (a*) and yellowness (b*) colour values of control and treatment snack differed significantly ($p<0.01$), with treatment group having lowest L* a* b* colour values (26.44 ± 0.45, 10.38 ± 0.28 and 15.10 ± 0.53, respectively on "0" day) when compared to those 37.74 ±0.11, 12.45±0.11 and 23.87±0.27, on "0" day) of control. This might be due to the dark colour of the flour. Observed result was in accordance with Kumar *et al.* (2015), who also observed decreased L* a* b* values for finger millet incorporated chevon patties and they concluded that the high tannin and polyphenolic contents in finger millet resulted in dark colour of final product on cooking. Colour values were found to be significantly ($p<0.05$) increasing during storage for both samples except a* value of control, which decreased during storage.

Microbiological Parameters

No significant difference was observed in aerobic plate count (APC) between control and treatment snacks, except on 15 days and 75 days of storage. During storage in both samples the counts significantly ($p<0.01$) decreased on day 15 and significantly ($p<0.01$) increased from day 60 onwards till day 90. There was no

DOI 10.5455/ijlr.20190821054551

significant difference in yeast and mould count between the samples except on day 75. From day 0 to day 30, yeast and mould counts of both the samples remained same or decreased, and from day 30 onwards there was a significant ($p<0.05$) increase in the counts in both samples. Jayathilakan *et al.* (2015) in consonance with this study also observed an increase in aerobic plate count and yeast and mould count in chicken biscuits during ambient temperature storage.

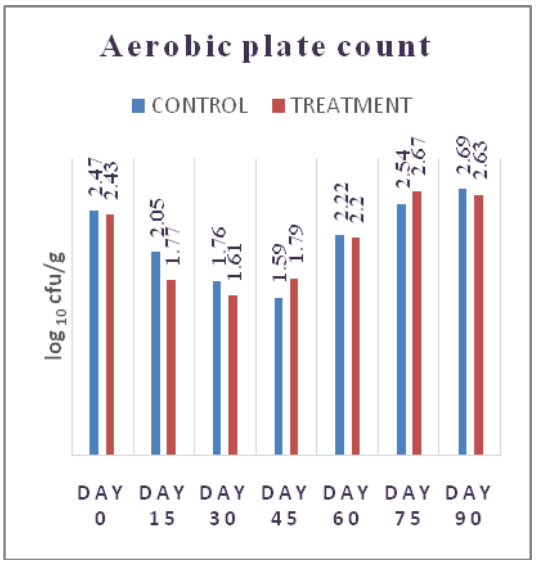

Fig. 5: Aerobic plate count (log_{10} cfu/g)

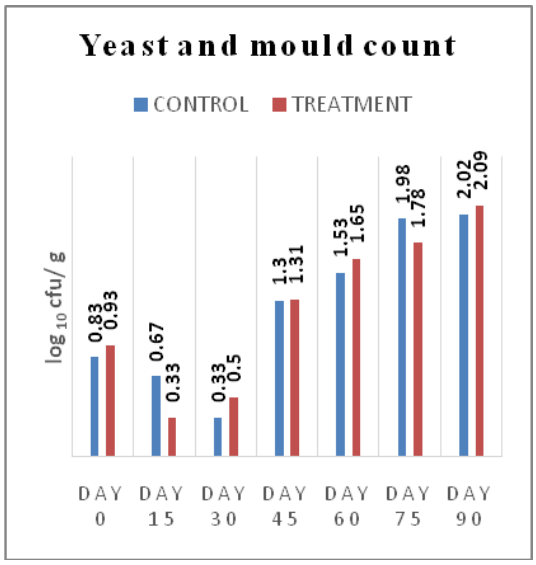

Fig. 6: Yeast and mould count (log_{10} cfu/g)

Texture Profile Analysis

Treatment snack was found to have significantly ($p<0.01$) lower hardness values when compared to control snack during storage. Highest hardness values for control group might be due to the presence of flours which are rich in carbohydrate and due to the absence of meat. Hardness values was found to be decreasing significantly ($p<0.01$) during storage in both samples. Van Den Sman *et al.* (2018) stated that hard, coarse and non-crispy textures of the products were due to the absence of fillers or due to the addition of numerous hard fillers Adhesiveness values were highly significant ($p<0.01$) between samples, with significantly ($p<0.01$) higher values for treatment snack. The values were found to remain similar during storage in both samples.

Table 5: Hardness values (N/cm^2) of control and treatment snacks on different storage days

Sample	Day 0	Day 15	Day 30	Day 45	Day 60	F-value (p-value)
Control	431.93 ± 1.30^{A}	423.26 ± 1.75^{B}	426.42 ± 1.55^{AB}	417.56 ± 1.23^{C}	413.00 ± 1.12^{D}	27.028^{**} (<0.001)
Treatment	274.48 ± 2.26^{A}	264.22 ± 1.08^{B}	250.41 ± 4.39^{BC}	241.36 ± 2.10^{C}	230.36 ± 1.43^{D}	51.681^{**} (<0.001)
t-value (p-value)	60.416^{**} (<0.001)	77.240^{**} (<0.001)	37.771^{**} (<0.001)	72.393^{**} (<0.001)	100.740^{**} (<0.001)	

 DOI 10.5455/ijlr.20190821054551

Proximate Principles

Control snack was observed to have significantly ($p<0.01$) higher moisture content on all days of storage except on day 90. The moisture level in both snacks showed a significantly ($p<0.01$) increasing trend during storage. Fat, ash and energy values of treatment snack were significantly ($p<0.05$) higher, due to the presence of meat, whereas control snack exhibited significantly ($p<0.01$) higher carbohydrate content. No significant difference was noted between the treatment and control snack, in respect of protein content. Verma *et al*. (2012) reported that fat, ash, protein and moisture contents would increase and crude fibre content would decrease with addition of meat. Control snacks had higher dietary fibre content (18%) when compared to treatment snack which had a dietary fibre content of 16.3%.

Sensory Attributes

Appearance scores for control and treatment snack were similar on all days expect day 15 and 30, where control snack scored higher due to the dark colour of treatment snack. Control snack score varied significantly ($p<0.05$) during storage but that of treatment snack remain similar. Addition of meat resulted in significantly ($p<0.01$) higher flavour scores in treatment snack and it varied significantly ($p<0.01$) during storage, whereas no difference was recorded in control snack.

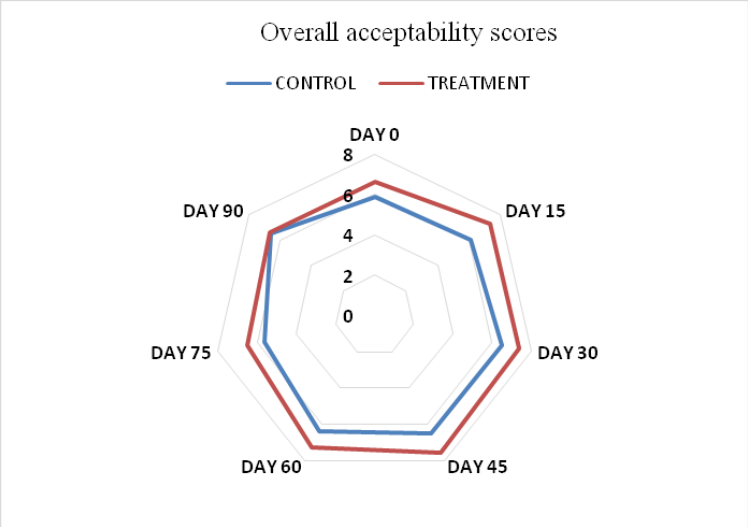

Fig .7: Overall acceptability scores of control and treatment snacks on different storage days

Jaiswal *et al.* (2015) stated that addition of meat could increase the flavour, meat flavour intensity and overall acceptability of a product. Similar texture scores were observed for both control and treatment snacks and during storage significant ($p<0.01$) reduction in texture scores was noted on day 75. Meat flavour intensity scores of treatment group increased from day 15. After taste and overall acceptability

DOI 10.5455/ijlr.20190821054551

scores differed significantly ($p<0.01$) with highest values for treatment snack. Acceptability of treatment snack decreased significantly ($p<0.01$) during storage but no difference was observed in control snack.

Conclusion

Ready-to-eat snacks were formulated by incorporating chicken meat at 50 % level and finger millet flour at 46.5%. These snacks when packed under modified atmosphere packaging remained stable up to 90 days at ambient temperature with acceptable sensory attributes and microbial quality and high nutritive value.

Acknowledgement

Authors would like to acknowledge Kerala Veterinary and Animal Sciences University, Pookode, Wayanad for providing research fund and facilities required to conduct the research.

References

1. AOAC (2016). Meat and meat products. In Official Methods of Analysis of Analytical Chemists. (20th Ed.), Association of Official Analytical Chemists. Inc., Rockville, Maryland. 1-34.
2. Badr, H.M., 2004. Use of irradiation to control foodborne pathogens and extend the refrigerated market life of rabbit meat. *Meat Science*, 67(4), 541-548.
3. Bourne, M. C. (1978). Texture profile analysis. *Food Technology*, 32: 62–66.
4. Beuchat, L.R. and Cousin, M.A. 2001. Yeast and Molds. In: Downes, F.P., and Ito, K(ed.), Compendium of Methods for the Microbiological Examination of Foods. (4thEd.). APHA, Washington, D.C. pp. 209-213.
5. Choi, Y., Choi, J., Han, D., Kim, H., Lee, M., Lee, E. (2008). Effects of rice bran fiber on quality of low-fat tteokgalbi. *Food Science and Biotechnology*, 17(5), 959–964.
6. Devi, P.B., Vijayabharathi, R., Sathyabama, S., Malleshi, N.G. and Priyadarisini, V.B. (2014). Health benefits of finger millet (*Eleusine coracana* L.) polyphenols and dietary fiber: a review. *Journal of Food Science and Technology*, 51(6), 1021-1040.
7. Escarpa, A. and González, M.C. (2001). Approach to the content of total extractable phenolic compounds from different food samples by comparison of chromatographic and spectrophotometric methods. *Analytica Chimica Acta*, 427(1), 119-127.
8. Jaiswal, R.K., Pathak, G.M. and Mandal, T. (2015). Texture profile analysis of chicken meat biscuits at ambient temperature in aerobic packaging. *Vet. Pract.* 16 (1), 125-126.
9. Jayathilakan, K., Sulthana, K., Harilal, P.T. and Pandey, M. C. (2015). Effect of ground chicken incorporation on the nutritional, textural and sensory characteristics of shelf stable biscuits. *International Journal for Advanced Research*, 3 (6), 751-761.
10. Jones JM, Engleson J (2010) Whole grains: benefits and challenges. Annual Review of Food Science and Technology, 1,19–40
11. Jose, S. (2012). Process development for dehydrated flavoured chicken shreds from spent hen meat. Doctoral dissertation, MAFSU, Nagpur, 48p.
12. Kumar, D., Chatli, M.K., Mehta, N., Verma, A.K. and Kumar, P. (2015). Quality evaluation of chevon patties fortified with dietary fibre. *The Indian Journal of Small Ruminants*,21 (1),85-91.
13. Kumar, P., Verma, A.K., Kumar, D., Umaraw, P., Mehta, N. and Malav, O.P. (2019). Meat Snacks: A novel technological perspective. In: Innovations in Traditional Foods, Woodhead Publishing, Cambridge, pp. 293-321.

 DOI 10.5455/ijlr.20190821054551

14. McKeown NM (2002) Whole grain intake is favorably associated with metabolic risk factors for type 2 diabetes and cardiovascular disease in the Framingham Offspring Study. *The American Journal of Clinical Nutrition*, 76 (2),390–398.
15. Morton, R.D. 2001. Aerobic plate count. In: Downes, F.P., and Ito, K (ed.), Compendium of Methods for the Microbiological Examination of Foods. (4th Ed.). APHA, Washington, D.C. pp: 63-67.
16. Page, J.K., Wulf, D.M. and Schwotzer, T.R. (2001). A survey of beef muscle colour and pH. *Journal of Animal Science*, 79 (3),678-687.
17. Pavan, M., Kuriyan, Y., Nayar, R., Rajgopal, K., Sathu, T., & Sunanda, C. (2019). Development and Quality Evaluation of Chicken Nuggets Incorporated with Finger Millet (*Eleusine coracana*). *International Journal of Livestock Research*, 9(7), 116-126.
18. Pearson, D. (1968). Application of chemical method for assessment of beef quality. In methods related to protein breakdown. *Journal of the Science of Food and Agriculture*, 19 (7),366- 369
19. Raja, W.H., Kumar, S., Bhat, Z.F. and Kumar, P. (2014). Effect of ambient storage on the quality characteristics of aerobically packaged fish curls incorporated with different flours. Springerplus. 3(1), 106.
20. Snedecor, G.W. and Cochran, W.G. (1994). Statistical Methods. 8th edition. The Iowa State University, Ames, Iowa, p 313.
21. Thomas, R., Anjaneyulu, A.S.R. and Kondaiah, N. (2008). Development of shelf stable pork sausages using hurdle technology and their quality at ambient temperature (37±10 C) storage. *Meat Science*, 79 (1), 1-12.
22. Talukder, S., Mendiratta, S.K., Soni, A., Singh, T.P., Chhangte, L., Kumar, R.R., Goswami, M., Malav, O.P. and Irshad, A. (2015). Development and quality characterization of mutton snack. *Nutrition and Food Science*, 45 (6), 873-882.
23. Van Der Sman, R.G.M., Vollebregt, H.M., Meinders, M.B.J. and Beri, A. (2018). Effects of filler ingredients on the structure and texture of starchy, extruded snacks. *Food Structure*, 18, 1-13.
24. Verma, A. K., Pathak, V. and Singh, V. P. (2012). Incorporation of chicken meat in rice flour-based noodles and its effects on physicochemical and sensory qualities. *International Journal of Current Research*, 4 (12), 461-466.
25. Witte, V.C., Krause, G.F. and Bailey, M.E. 1970. A new extraction method for determining 2-thiobarbituric acid values of pork and beef during storage. *Journal of Food Science*,35(5),582-585.

DOI 10.5455/ijlr.20190821054551