Research Article

Quality Characteristics of Beef Sausage Incorporated with Chickpea Flour

Ibtisam H. Elhassan[1], Eiman O. Basheer[2], Ahmed El. Ismaiel[3], Azza M. Khalid[4*], Mohammed A. Alnor[5],
Nada A. Fath Elrahman[6], Randa A. Ibrahim[7] and Wala S. Babekir[8]

[1,2,3,5,6]NFRC/National Food Research Center, Shambat, Sudan; [4]Dept. of Poultry production, College of Animal Production,
University of Bahri, Sudan; [7,8]Dept. of Food Science and Technology, College of Agriculture, University of Sudan
azzamutwakil@yahoo.com*; +249912892210

Abstract

This study was conducted to evaluate the quality characteristics of beef sausage incorporated with chickpea flour. Four levels of chickpea flour were incorporated in beef sausage, stuffed in natural casings, linked and then frozen at −18°C. Physico-chemical, microbiological and sensory properties were determined in sausage. Protein content of sausages incorporated with chickpea flour significantly (P≤0.05) increased as chickpea levels increased. On the contrary, moisture content and cooking loss significantly (P≤0.05) decreased. Control sample had the highest score of appearance, taste, texture and overall acceptability. Total viable bacterial count (TVBC) significantly (P≤0.05) affected as chickpea level increased. The highest total viable bacterial count for untreated sample was 6.16 log10.cfu/g, while, the lowest total viable bacterial count was 4.75 log10.cfu/g for 30% chickpea incorporated sausage. The findings showed that all the sausage samples were *Salmonella* free.

Introduction

Sudan has a huge animal resource, estimated to be more than 106 million head, 30.37 million cattle, 4.80 million camel, 40.21 million sheep and 31.32 million goats (MLFR, 2015). Meat and meat products are excellent sources of protein, fat, minerals and vitamins which are important components of the diet for human (Basheer, 2017). Sausage is one of the old product in which fresh comminuted meat is modified by various processing methods to yield desirable organoleptic and keeping properties. Meat sausage is more economical than whole meat since they are manufactured from low quality meats and other ingredients. A part from being more economical, sausage product is also found to be of good nutritional values and contains significant amount of high quality protein (Eltom, 2017). Chickpea is widely grown legume in the Mediterranean and Eastern countries and probably it is not indigenous to the Sudan. Chickpea as other dried legumes provides a non-processed, storable and transportable portentous food concentrate. In addition to its nutritive value, several authors indicated that a diet containing chickpea decreased the serum cholesterol concentration in human and experimental animals (Ali, 2003). Chickpea is a very good source of carbohydrates and protein which together contain above 80% of total dry seeds weight. The starch content reported for whole seed of several chickpea cultivars ranged between 41.0 and 50.8 with a mean of 47.3%.

Total seed carbohydrates were reported to vary from 52.4 to 70.9%. The amylase content of chickpea starch varied from 520 depending on the analytical method used (Kishor *et al.,* 2017). This study evaluated the production of low cost sausages by adding chickpea flour and evaluated the physiochemical, microbial and sensory properties.

Materials and methods

Chick pea flour preparation: Chickpea (3 Kgs) were purchased from a local market. Then, it was cleaned and grounded using an electrical grinder (Model TCB, 12) and chickpea flour was obtained.

Sausage preparation: Low cost meat and animal fat were ground, and chickpea flour at level of 10%, 20% and 30% along with other ingredients were added. The content was well mixed to obtain a homogenous mixture. The homogenous mixture was stuffed in natural casings and kept frozen at -18°C.

Analytical methods: Moisture content, crude protein, fat and cooking loss were determined according to the AOAC (2005). Microbial analysis (TVBC, and *Salmonella*) were determined according to Harrigan and McCance (1976). Sensory evaluation was carried out according to Cross *et al.* (1978).

Table 1. Physico-chemical characteristics of low cost sausage incorporated with chickpea flour.

Parameters	Levels of chickpea flour				
	Control	10%	20%	30%	S.E
Moisture	93.72[a]	69.30[b]	68.10[c]	65.56[d]	±2.61
Fat	7.20[a]	7.18[ab]	7.17[abc]	7.17[ab]	±0.65
Protein	18.92[b]	19.53[ab]	21.66[ab]	22.24[a]	±0.92
Cooking loss	11.32[a]	10.15[a]	8.90[a]	7.65[a]	±1.02

Values are means ± SD. Means in the same column bearing the same superscript small letters are not significantly different (P≥0.05).

Table 2: Sensory of low cost sausage incorporated with chickpea flour.

Parameters	Levels of chickpea flour				
	Control	10%	20%	30%	S.E
Moisture	Appearance	6.70[a]	6.15[b]	5.15[c]	4.35[d]
Fat	Taste	6.30[a]	5.90[b]	4.40[c]	3.00[d]
Protein	Texture	6.50[a]	5.14[b]	4.30[c]	3.50[d]
Cooking loss	Juiciness	6.15[a]	6.0[b]	5.40[c]	4.65[d]
Overall acceptability	6.25[a]	5.86[b]	4.65[c]	4.22[d]	±0.34

Statistical analysis: Data collected were subjected to the analysis of variance and Duncan's Multiple Range Test was used to separate means (Steel and Torrie, 1980).

Results and discussion

Table 1 showed significant differences (P≤0.05) in moisture content among the different treatments. The control sample had the highest moisture 93.72%, followed by 69.30%, 68.10% and 65.56% for 10%, 20% and 30% chickpea flour respectively. The results showed that the moisture content decreases with the increase in the level of chickpea flour, this reduction in moisture content could be attributed to the fact that, chickpea had better water binding capacities (Judge *et al.,* 1990). Similar observation was noticed by Ali (2003). As for fat content, the results revealed that there were no significant (P≥0.05) differences in fat content among the different treatments. Sausage samples incorporated with 10%, 20% and 30% chickpea had fat content of 7.20%, 7.18%, 7.17% and 7.15% respectively. Elbakheet (2008) reported that the fat content of sausage significantly (P≥0.05) affected by germ flour. Furthermore, fat in meat is found both between muscles and within muscles, in both locations, fat contributes to overall flavor and juiciness in meats (Basheer, 2017).

Regarding protein content, the results indicated that there were a significant (P≤0.05) differences in protein content among the different treatments. Sample containing 30% chickpea had the highest protein content 22.24%, while, the untreated sample had the lowest protein content 18.92%. Similar observation was reported by Elbakheet (2008) who found that, protein content of beef patties increased with the increase of corn germ flour.

Ali (2003) reported that the incorporated beef sausage with chickpea flour lead to increased protein content of product. Table 1 revealed that the cooking loss of sausage samples significantly (P≤0.05) affected with the increment of chickpea flour levels. Sausage samples containing 30% chickpea flour recorded the lowest cooking loss 7.65%, whereas, the untreated sample recorded the highest cooking loss 11.32%. Similar observation was noticed by Elbakheet (2008) who found that, cooking loss of beef patties decreased with the increase of corn germ flour. The findings coincide with that stated by Basheer (2017) who recorded higher water holding capacity of sausage and lower cooking loss.

Sensory evaluation: The effect of incorporated chickpea in sausage processing on sensory properties is shown in Table 2. Appearance score decreased by increase of chickpea level. Untreated has a higher appearance score 6.70 among all other treatments, while 30% chickpea had a lowest score of 4.35. These observations were in agreement with Elbakheet (2008) who found significant decrease in appearance as treatment with corn flour. Ali (2003) reported that sausage formulated with 0%, 10% and 20% were color score of 5.57, 4.54 and 4.70, respectively. The mean results of taste are shown in Table 2, generally taste score of sausage increased with the increase of chickpea level significantly. Control sample has the highest taste rank of 6.30, followed by 10%, 20% and 30%. Ali (2003) reported that, taste score of sausage significantly (P≤0.05) affected with chickpea level increased. The panelists detected that the incorporation of chickpea flour decreased juiciness of the beef sausage.

Untreated sample had the highest score of 6.15 of juiciness among all other treatments. These results were closed to those obtained by Eltom (2017). Basheer (2017) stated that the better juiciness and lower cooking losses. Addition of chickpea flour to beef sausage resulted in substantial decrease in texture, particularly as the level of chickpea flour increased. These results coincides with Ali (2003) who reported that the texture score of sausage decreased when chickpea level increased.

Microbiological aspects

Total Viable Bacterial Count (TVBC): Data in Table 3, shows that there was an significant ($P \leq 0.05$) difference in total viable bacteria count of beef sausage samples incorporated with chickpea flour. Highest TVBC was recorded for sausage sample incorporated with 30% chickpea (6.16 log10 cfu/g), while, lowest TVBC was recorded for control sample (4.75 log10 cfu/g). Ali (2003) reported that, TVBC of sausage significantly ($P \leq 0.05$) increased in chickpea incorporated sausage. Judge *et al.* (1990) reported that TVBC is an major indicator of microbiological contamination.

Salmonella: Table 3 showed that there was no presence of *Salmonella* among sausage samples. These results out of Sudanese standard (SSMO, 2008) mentioned that, meat suitable for human consumption must be *Salmonella* free. Basheer (2017) detected no *Salmonella* in samples under investigation. Similar trend was observed by Eltom (2017) who reported *Salmonella* free meat samples. Judge *et al.* (1990) reported that the presence of *Salmonella* in beef products is an indication that the system for controlling contamination is not working. The presence of *Salmonella* indicates poor food preparation and health status.

Conclusion

Incorporation of chickpea flour to beef sausage decreased the appearance, taste, juiciness and texture score of beef sausage. The panelists preferred untreated sample when compared to another treatments. Consequently, production of such low cost products will meet the growing needs of the increasing number of meat consumers for fast food products and affordable prices.

References

1. Ali. A.E. 2003. Utilization of chickpea flour in the manufacture of beef sausage and burger. Master Dissertation, Elzaeim El Azhari, Retrieved from http://www.ElzaeimElAzhariUniversity.
2. AOAC. 2005. Official Methods of Analysis of the Association of Analytical Chemists International, 18thed., MD Official methods, Gathersburg, USA.
3. Basheer, E.O. 2017. Development and quality evaluation of beef frankfurter enriched with Omega-3 Unsaturated Fatty Acids. Doctoral Dissertation, Khartoum University. Retrieved from http://www.KhartoumUniversity.
4. Cross, H.R., Moen, R. and Stanifield, M.S. 1978. Guidelines for training and testing judges for sensory analysis of meat quality. *JF. Technol.* 32: 48-54.
5. Elbakheet, S. 2008. Utilization of wheat germ flour in the processing of beef sausage. Master dissertation, Khartoum University. Retrieved from http://www.Khartoum University.
6. Eltom. W.M. 2017. Assessment of microbial growth and oxidative rancidity of beef sausage incorporated with mint (*Menthaspicata*) Powder. Doctoral Dissertation, Khartoum University. Retrieved from http://www.Khartoum University.
7. Harrigan, E. and McCance, M. 1976. Laboratory methods in Microbiology. Academic Press purplish, London and New York, pp.27-3003.
8. Judge, M.A., Forrest, J., Hedrick, B. and Merkel, R. 1994. Principles of Meat Science Kendall/Hunt Publishing Co., Dubuque, IA, USA, pp.99-100.
9. Kishor, K., David, J., Tiwari, S., Singh, K. and Rai. S. 2017. Nutritional Composition of Chickpea (*arietinumcicer*) milk. *IJ. Chemist Stud.* 5(4): 1941-1944.
10. MLFR. 2015. Ministry of livestock, Fishers and Rangelands. Department of information and statistics- Sudan.
11. SSMO. 2008. Sudanese Standards and Metrology Organization, No, 295.
12. Steel, R.G.D. and Torrie, J.H. 1980. Principles and procedures of statistics. MC Grow Hill, New York, USA, pp.633-657.