Vol.4 *No.1* *July-September 2016* *ISSN : 2321-6387*

Development and Quality Evaluation of Low Fat Functional Goat Meat Sausages with added Rice Bran Oil

M. Anna Anandh and R. Annal Villi

Tamil Nadu Veterinary and Animal Sciences University,
Department of Livestock Products Technology,
Veterinary College and Research Institute, Orathanadu - 614 625, Thanjavur District

Article Received on 12.05.2016 *Article Published on 05.07.2016*

Abstract

A study was undertaken to study the effect of incorporation of rice bran oil on goat meat sausages. Functional goat meat sausages with 10, 20 and 30% levels of rice bran oil were prepared and their quality evaluated. The goat meat sausages prepared with 15% goat fat was used as control. Significant ($p<0.01$) increase were observed for pH, fat separation, diameter shrinkage, and protein content contents in rice bran oil incorporated functional goat meat sausages than control. However, significant ($p< 0.01$) reverse trends were observed for emulsion stability, product yield, moisture and fat contents. Sensory evaluation scores for appearance & colour, flavor, tenderness, juiciness, binding and overall acceptability were highest for 20% rice bran oil incorporated functional goat meat sausages followed by 30% and 10% rice bran oil incorporated functional goat meat sausages. Physico - chemical and sensory evaluation scores of 20 % rice bran oil incorporated functional goat meat sausages were more acceptable as compared to other rice bran incorporated functional goat meat sausages and control goat meat sausage. Thus, it can be concluded that 20 % rice bran oil can be successfully used for preparation of functional goat meat sausages of acceptable quality without affecting quality and acceptability.

Key words: *Goat, Meat, Functional, Sausage, Quality, Acceptability*

Introduction

Goat meat is one of the choicest meats and has huge domestic demand in India. Health conscious consumers do not prefer products rich in animal fat due to presence of high amount of saturated fat. It is necessary to replacement of animal fat with vegetable fat / oil in the preparation processed value added meat products. The substitution of animal fat with vegetable oils has been suggested to improve the fatty acid profile and to decrease the cholesterol levels of meat products (Ozvural and Vural, 2008). In recent years researches in the meat industry were aimed at replacing animal fats with vegetable fats (oils), rich in mono and polyunsaturated essential fatty acids. Rice bran oil has highest quality among other oils in terms of its cooking quality, shelf life, fatty acid composition, nutritive value, flavor, taste and cooking economy (Rogers *et al.*, 1993). Rice bran oil is an abundant source of primary antioxidants including Gamma-Oryzanol, alpha, beta, gamma and delta tocopherol isomers, as well as the most active antioxidants, the tocotrienols (Reddy et al., 2014). Research on meat

products using rice bran oil is limited. The objective of this study was to investigate the effect of replacing animal fat with rice bran oil on quality acceptability of goat meat sausages.

Materials and methods

Goat meat

Fresh goat skeletal meat and fat were purchased from local goat meat stalls. The goat skeletal meat was cut into small chunks and frozen for 1-2 h to ensure easy mincing. The goat meat chunks were minced twice through the meat mincer (Mado, Germany) using 5 mm plate. The minced GM was used in the preparation of cooked sausages.

Rice bran oil

The rice bran oil (Fortune brand) used in present investigation was obtained from local market.

Casings

Cellulose casings of average diameter of 25 mm (Viskase, USA) were purchased from the local market.

Product formulation

The basic control goat meat sausage recipe consisted of 15% goat fat. The goat fat replaced at 10, 20 and 30% of the rice bran oil in the basic control formulation. Each formulation also contained sodium tri-poly phosphate (0.5%), salt (2.0%), fat (5.0), maida (4.0 %), mashed cooked potato (35.0 %), condiments mix (5.0% - onion, garlic and ginger in the ratio of 3:2:1), spice mix (3.5%) and ice flakes (10.0%).

Product preparation

The minced goat meat along with sodium tri-poly phosphate and salt were chopped in a bowl chopper (Scharffen, Germany) for 1 min and fat (control) / different level of rice bran oil (treatment) were added and chopped for another 2 min then spice mix, green condiments and added water in the form ice flakes were added and chopped for few min. At the final step cooked mashed potato and maida was added and chopped for another 1.5 min. Emulsion was then stuffed in cellulose casing of 25mm diameter (Viskase, USA), using a Hydraulic Sausage Stuffer (Dadaux, France) and linked manually. Stuffed sausages were kept in refrigerator (4 ± 2oC) for 1 hr to ensure proper setting. Sausages were then cooked in water bath at 80 ± 2oC for 15 minutes so as to reach core temperature of 75 ± 2oC. Total of four batches of sausages were prepared. The sausages prepared were packed in polyethylene bags and kept in refrigerator (4 ± 2oC). The cooked sausage samples were then analyzed for various physico – chemical characteristics and sensory quality attributes.

Physico – chemical analysis

Digital pH meter was used for pH measurement. The weight of cooked sausage was recorded before and after cooking and the product yield was calculated (product yield = weight of cooked sausage / weight of raw sausage × 100) and expressed as percentage. Emulsion stability (ES) was determined as per the method of Kondaiah*et al.* (1985). The emulsion samples (25 g) in polyethylene bags were heated at 80C in a thermostatically controlled water bath for 20 min. After draining out the exudates,

the cooked mass was cooled, weighed and the yield was recorded as emulsion stability percent. Fat separation of sausage samples was estimated according to (Kondaiah and Panda, 1989). The diameters of cooked sausages were measured before and after cooking with a digital vernier caliper at 3 random locations. Reduction in diameter shrinkage was expressed in percentage. The moisture, protein and fat contents of cooked sausages were determined by using hot air oven, Kjeldahl's assembly and Soxhlet ether extraction apparatus, respectively (AOAC 1995).

Sensory evaluation

Sensory evaluation was conducted with semi-trained panelists. Slices of cooked sausage were served to a semi-trained panelist to determine sensory characteristics. The sensory attributes like appearance and colour, flavour, juiciness, tenderness, binding and overall palatability were evaluated on 8 - point descriptive scale as suggested by Keeton (1983) where in 1 is extremely undesirable and 8 is extremely desirable.

Statistical analysis

The experiment was repeated 4 times. The data generated from each experiment were analysed statistically by following standard procedures (Snedecor and Cochran 1989) for comparing the means and to determine the effect of treatment.

Results and Discussion

Physico - chemical characteristics

Results of physic – chemical parameters of functional goat meat sausages incorporated rice bran oil are presented in Table 1. The pH values of functional goat meat sausagesincreased with increasing levels of rice bran oil. The pH value of 30% rice bran incorporated cooked sausage was significantly ($p<0.01$) higher as compared to other rice bran oil incorporated of functional goat meat sausages and control sausage. However, no significant difference was observed between control, 10 and 20% rice bran oil incorporated cooked sausages. Pal and Agnihotri (1996) also observed similar pH changes in vegetable oil incorporated fresh chevon sausage. Emulsion stability decreased with increasing levels of rice bran oil. The mean emulsion stability value was significantly ($p<0.01$) lower for 30% rice bran oil incorporated functional goat meat sausages followed by 20, 10% rice bran oil incorporated functional goat meat sausages and control goat meat sausage. The fat separation value of functional goat meat sausages increased with increasing levels of rice bran oil. The fat separation value of rice bran incorporated functional goat meat sausages differed significantly ($p<0.01$) between them and between control. The mean product yield of functional goat meat sausages decreased with increasing levels of rice bran oil. The product yield was significantly ($p<0.01$) higher for control and 10% rice bran oil incorporated functional goat meat sausages, but the value did not differ significantly between them. The product yield of 20 % and 30% rice bran oil incorporated functional goat meat sausages also did not differ significantly between them. Low product

yield of rice bran oil incorporated functional goat meat sausages might be due to low higher fat separation during cooking. This may be due to lower batter stability and higher fat separation as well as lesser retention of moisture in the product Pal and Agnihotri (1996). Emulsion stability and fat separation as both the parameters are closely inter-related and have direct bearing on cooking yield of the product. Batter stability is a measure of cooking loss and indicates percent loss of fat, water and solids from a meat batter on heating (Salahuddin *et al.*, 1992). The mean diameter shrinkage values were did not differ significantly between control and rice bran oil incorporated functional goat meat sausages. The moisture and fat contents decreased whereas, protein content increased with increasing levels of rice bran oil. The addition of rice bran oil only slightly affected the composition of the final product, which was in agreement with Acton *et al, (*1982).

Table 1: Effect of incorporation of different levels of rice bran oil on physico - chemical characteristics of functional goat meat sausages (Mean ± SE)

Physico - chemical charaterisctics (n = 4)	Level of rice bran oil			
	Control	10	20	30
pH	6.05 ± 0.08^{a}	6.08 ± 0.04^{a}	6.09 ±0.05^{a}	6.10 ±0.02^{a}
Emulsion stability (%)	16.08 ±.04^{a}	14.18 ± 0.01^{b}	12.08 ± 0.02^{c}	8.12 ±0.03^{d}
Fat separation (%)	0.75 ±0.31^{a}	1.92 ± 0.01^{b}	2.18 ± 0.04^{c}	3.17 ± 0.08^{d}
Diameter shrinkage (%)	14.12± 0.10^{a}	14.30 ± 0.10^{a}	14.35 ± 0.12^{a}	14.42 ± 0.12^{a}
Product yield (%)	96.13 ±0.04^{a}	94.22 ± 0.06^{a}	92.40 ±.002^{b}	90.78 ± 0.04^{b}
Moisture (%)	69.14 ±0.16^{a}	69.45 ± 0.12^{a}	68.52 ±0.18^{b}	68.19 ± 0.08^{b}
Fat (%)	12.78 ± 0.14^{a}	12.53 ± 0.12^{a}	11.41 ±0.10^{b}	11.18 ± 0.10^{b}
Protein (%)	17.18 ± 0.12^{a}	18.64 ±0.15^{b}	18.92 ±0.08^{b}	19.12 ± 0.12^{b}

Means bearing same superscripts row-wise do not differ significantly ($p<0.01$).

Sensory characteristics

Results of sensory evaluation scores of functional goat meat sausages incorporated with rice bran oil are presented in Table 2. Among treatments, the sensory scores for appearance and colour, flavour, juiciness, tenderness, binding and overall palatability were significantly ($p< 0.01$) higher for 20% rice bran oil incorporated functional goat meat sausages followed by 30 % and 10 % rice bran oil incorporated functional goat meat sausages. The sensory scores for appearance and colour, flavour, juiciness, tenderness, binding and overall palatability between control and rice bran oil incorporated functional goat meat sausages differ significantly ($p<0.01$) between them.

Table 2: Effect of incorporation of different levels of rice bran oil on sensory characteristics of functional goat meat sausages (Mean ± SE)

Sensory Characteristics** (n= 20)	Level of rice bran oil			
	Control	10	20	30
Appearance and colour	6.93 ± 0.15[a]	7.45 ± 0.12[b]	7.82 ±0.14[c]	7.68 ±0.12[d]
Flavour	6.15 ± 0.15[a]	7.32 ± 0.14[b]	7.82 ±0.12[c]	7.61 ±0.15[d]
Texture	6.32 ± 0.10[a]	7.50 ± 0.13[b]	7.84 ±0.14[c]	7.12 ±0.14[d]
Juciness	6.46 ± 0.14[a]	7.45 ± 0.12[b]	8.13 ±0.10[c]	7.44. ±0.12[d]
Oveall acceptability	6.50 ± 0.12[a]	7.65 ±0.10[b]	8.12 ±0.12[c]	7.64 ±0.12[d]

Means bearing same superscripts row-wise do not differ significantly ($p<0.01$).

**Sensory attributes of functional goat meat patties were evaluated on a 8 – point descriptive scale (wherein 1 = extremely undesirable; 8 = extremely desirable).

Conclusion

Finding of this study have shown that 20 % rice bran oil can be successfully used for preparation of functional goat meat sausages of acceptable quality. Therefore, it could be concluded that development of functional goat meat sausages possible with improved nutritional and sensory quality by complete replacement of goat fat with rice bran oil.

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