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Research Note

Optimization of Different Leguminous Extenders on Spent Breeder Hen Meat Balls

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ABSTRACT

Spent breeder hen meat balls using different types of flours were analyzed for their physico-chemical and sensory properties by repeated trials. Three different extenders *viz*. black gram flour, green gram flour and red gram flour at the level of 10% were used to formulate the meat balls. Among formulations spent breeder hen meat balls incorporated with red gram flour had moderately higher values of emulsion stability, water holding capacity, moisture retention, crude fat and fiber values compared to all other formulations though it was not significant ($p>0.05$) between other flour extended formulations, but there was significant difference ($p<0.05$) with control. According to sensory evaluation results, formulation with black gram flour had high ($p<0.05$) juiciness and overall acceptability scores. The meat ball prepared with any of these extenders were organoleptically acceptable, however, the meat with black gram flour had better sensory quality attributes to other leguminous flours.

Keywords : *Breeder hen, Meat balls, Leguminous extender, Process optimization*

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The consumption of poultry meat and meat products is growing all over the world (Mielnik *et al.* 2002). Raising cost of chicken broiler meat in India has created a need for alternatives. One such alternative is utilization of less expensive meat from spent breeder hens to produce cheaper and economically viable nutritious products. Spent breeder hen meat is tough, less juicy and poor in functional properties because of high collagen content and cross linkages (Bailey 1984) as compared to normal broiler meat and is not much liked by the consumers. So the disposal of spent breeder hen is expected to receive great concern among the poultry farmers. Use of such meat in the development of value added products will therefore open an avenue for gainful utilization of spent breeder hen meat and improve the profitability of poultry industry. Consumer preference for broiler meat is hampering the marketing of spent chicken leaving a wide scope for the development of different varieties of comminuted and value added poultry products. Among different value added products, chicken meat balls are one of the products for utilizing the spent layers. Meat balls are popular food among consumers and there is a rising concern about the nutritive value of meat balls. Consumers prefer real meats over processed meats. Therefore, more and more studies about the nutrition and quality of meat balls have been conducted. Chicken meat balls are ready to eat specially with the addition of different types of protein extenders/vegetable protein supplements. Legumes provide energy, dietary fiber, proteins, minerals and vitamins required for human health. Legumes are considered as poor man's meat. They are generally good sources of slow release carbohydrates and are rich in proteins. Inclusion of legumes in the daily diet has many physiological effects in controlling and preventing various metabolic diseases such as diabetes mellitus, coronary heart diseases and colon cancer (Tharanathan and Mahadevamma 2003). The non-meat ingredients such as leguminous flours, starch, egg, whey protein and fat play a significant role in modification of the functional properties of meat products such as emulsification, water and fat binding capacity and textural properties (El.Mangoli *et al.* 1996; Gujral *et al*. 2002). In particular non meat proteins and carbohydrates are often used to enhance the texture of meat products (Hongsprabhas and Barbut 1999). Hence the present investigation was carried out to study the effect of supplementation of three different protein extenders on the physico-chemical, proximate and sensory properties of spent breeder hen meat balls.

Raw material: Spent breeder hens (Local Lingapuram) of age 80 weeks were purchased from the local market and they were slaughtered conventionally in the slaughterhouse of Department of Livestock Products Technology, College of Veterinary Science, Tirupati and deboned manually to obtain bone less chicken meat. The skin, subcutaneous fat and connective tissue were trimmed off and the deboned chicken meat was used for further studies. Flours and other ingredients were purchased from local market. The formulation of meat

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balls contained 80% lean meat, 5 % vegetable oil, 2.5% spice mix, 5.5% condiment mix, 2% salt and 5% water. Three vegetable protein supplements *viz.* black gram, green gram and red gram flours were utilized in this study to replace the meat portion at the rate of 10% level each and control without any extender.

Evaluation of quality characteristics

Cooking loss: Cooking loss was estimated by recording the difference between the pre and post cooking weights of meat balls and expressed as percentage.

Emulsion stability: Emulsion stability was estimated as per the method outlined by Baliga and Madaiah (1971), with slight modifications 15 g of emulsion was weighed and packed in polyethylene bag and heated at 80°C for 20 min in a constant temperature water bath. The fluid released was drained and sample was weighed. The emulsion stability was calculated by using the formula mentioned below.

Water-holding capacity: The water-holding capacity of the emulsion was determined by following the procedure of Weirbicki *et al.* (1962).

Proximate composition: The percentage moisture, fat, crude protein and crude fiber were estimated as per AOAC (1995).

Organoleptic evaluation: The meat balls thus prepared as per the standardized formulations were deep fat fried for 3 minutes at 145 ± 5^{O}C and subjected to a 6 member taste panel including staff and students for sensory evaluation by using a 9 point hedonic scale.

Statistical analysis: The data thus obtained was subjected to statistical analysis using SPSS MAC, version 20.0, SPSS Chicago (US).

Physico-chemical properties: Mean ± SE values of the physico-chemical properties of spent breeder hen chicken meat balls were given in the Table 1. The mean percentage of cooking loss of control was significantly affected with leguminous flour treated samples. The highest cooking loss was observed in control than the treatments and significant difference ($p<0.05$) was there between the control and treatments. The higher cooking losses in meat balls were due to excess fat separation and water release during cooking (Reddy and Rao 1996). Lowest cooking loss was observed in treatment with black gram flour but no significant difference ($p>0.05$) was observed from the other treatments. Lower cooking loss may be due to optimum absorption of moisture from the emulsion during cooking and also due to the water binding capacity of flours (Reddy and Rao 1996). Serdaroglu *et al.* (2005) also observed higher cooking yields ($p<0.05$) in meat balls incorporated with lentil flour and bengal gram flour and the results are in accordance with Modi *et al.* (2003) in frozen chicken nuggets prepared with black gram flour, Prasad *et al.* (2011) in chicken kofta with inclusion of oat flour, casein and refined wheat flour and Bhaskar Reddy *et al.* (2012) in low fat chicken sausages added with oat flour.

Table 1: Influence of different leguminous flour on the physico-chemical and sensory quality of spent breeder hen meat balls (Mean ± S.E)

Parameter (%)	Control	Black gram flour	Green gram flour	Red gram flour
Cooking loss	30.40±0.34^{a}	21.00±0.35^{b}	20.40±0.17^{b}	21.47±0.36^{b}
Emulsion stability	70.90±0.41^{a}	79.45±0.66^{b}	83.80±0.25^{c}	82.57±0.20^{c}
WHC	52.40±0.43^{a}	58.85±1.21^{b}	58.80±1.13^{b}	59.30±0.71^{b}
Moisture	63.72±0.21^{a}	66.75±0.19^{b}	67.93±0.14^{c}	68.35±0.66^{c}
Crude protein	14.56±0.10^{d}	16.39±0.14^{b}	15.77±0.51^{c}	15.85±0.11^{d}
Crude fat	17.32±0.28^{a}	13.80±0.16^{b}	14.49±0.99^{b}	14.98±0.17^{b}
Crude fiber	1.17±0.04^{a}	1.66±0.06^{b}	2.13±0.06^{c}	2.85±0.08^{d}
Sensory quality				
Colour	6.25±0.25^{a}	7.50±0.28^{a}	7.50±0.28^{a}	6.00±0.40^{b}
Flavour	7.75±0.28^{a}	7.25±0.25^{a}	6.25±0.25^{a}	7.00±0.40^{a}
Tenderness	6.25±0.25^{a}	6.05±0.40^{a}	5.5±0.28^{a}	5.75±0.47^{a}
Juiciness	6.25±0.50^{a}	6.50±0.57^{b}	5.75±0.50^{a}	5.25±0.50^{a}
Over all acceptability	6.75±0.25^{a}	7.25±0.25^{b}	5.75±0.25^{c}	6.50±0.28^{c}

Means bearing at least one common superscript in the same row do not differ significantly ($p>0.05$)

The balls incorporated with 10% green gram flour observed highest values of emulsion stability ($p<0.05$) than the others treatments. The results obtained in this study are in agreement with the reports of Bhoyar *et al*. (1996) in frozen restructured chicken streaks using textured soya protein and Chandralekha *et al*. (2012) in value added chicken meat balls incorporated with soya flour, bengal gram flour and corn flour.

Spent breeder hen chicken meat balls incorporated with red gram flour have higher values of water holding capacity compared to all the other remaining formulations though it was not significant ($p>0.05$) with other flour extended formulations, but there was significant difference ($p<0.05$) with control. Serdaroglu *et al.* (2005) got higher water holding capacity for meat balls incorporated with legume flour compared to other formulations. This is probably due to the

high protein contents of legumes. Similarly, the addition of common bean flour increased water holding capacity of beef sausages (Dzudie *et al*. 2002).

Proximate analysis: The proximate analysis of spent breeder hen chicken meat balls by using different leguminous flours shown in Table 2. Spent breeder hen chicken meat balls with red gram flour observed highest moisture retention ($p<0.05$) than the control. The results are in accordance with the proximate analysis of commercial chicken meat balls and quail meat balls reported by Huda et *al.* (2009) and Ikhlas et *al.* (2011) respectively. The formulation of spent breeder hen chicken meat balls extended with black gram flours observed higher values of protein retention than control and other formulations. This may be due to incorporation of legume flours which increases the protein content in meat balls (Serdaroglu *et al*. 2005, USDA National Nutrient Database US Department of Agriculture). Several researchers have found that protein content of comminuted meat products increased with the addition of soya protein, black and green gram flours (Kaya and Gokalp 1990; Tomek serdaroglu and Gonencayoglu 1988; *et al*. 2003). The higher crude fat and fibre values were observed in meat balls with red gram flour compared to other formulations through it was not significant ($p>0.05$). Ikhlas *et* (2011) observed higher fat retention in quail meat balls using potato flour. These results are in agreement with Serdaroglu . (2005) in low fat meat balls containing legume flour as extenders.

Sensory evaluation*:* Sensory evaluation results shown in the Table 3. Sensory properties are among the major concerns for the utilization of plant proteins in foods. According to the sensory evaluation red gram flour incorporated meat ball received ($p<0.05$) higher scores than other treatments. This might be due to browning on deep fat frying. These results are in agreement with Chowdhury *et al*. (1994), Bhoyar *et al*. (1996); Dushyanthan *et al.* (2008) and Chandralekha *et al*. (2012). No significant difference ($p>0.05$) in flavor and tenderness scores were found among formulations containing added extenders. Meat balls incorporated with green gram had the higher scores ($p>0.05$) and red gram incorporated balls received lower scores. This increase in flavour scores might be due to green gram flour which have incorporated the flavour precursors in meat and relative abundance of free water to escape during high temperature of cooking to carry the flavour compounds like alcohols and esters having appreciable odour and taste. These results are in agreement with Reddy *et al.* (1999). Highest juiciness scores were noticed for meat balls incorporated with black gram flour which is significant ($p<0.05$) with other formulations. The highest juiciness scores of meat balls incorporated with black gram flour might be due to the fact that increased moisture retention of the product during cooking than the other treatments (Bhoyar *et al*. 1996; Serdaroglu *et al.* 2005). According to sensory evaluation results formulation with black gram flour had high ($p<0.05$) overall acceptability scores. Modi *et al.* (2003) investigated the effects of various legume flours (soya, bengal, green gram flours) on quality of buffalo burgers and found that none of the legume had detrimental effect on sensory properties at the level used. Serdaroglu *et al.* (2005) also observed high overall acceptability scores for the meat balls incorporated with different leguminous flours.

The results of this study suggest that leguminous flours (black, green and red gram) can be successfully used in meat ball formulations as extenders. Protein content of meat balls increased with the addition of leguminous flours and these leguminous flours are potential source of nonmeat protein for meat balls. The sensory evaluation was moderately liked for all types of flour used. Leguminous flours slightly increased the toughness of meat balls. The black gram flour formulation was most acceptable.

REFERENCES

AOAC (1995) Official methods of analysis. 6th edn. Association of official analytical chemists, Washington, DC, USA

Bailey AJ (1984). The chemistry of intra molecular collagen. In: The Royal Society of Chemistry, Burlington House. Recent Adv Chem Meat 22-47

Baliga BR, Madaiah N (1971) Preparation of mutton sausages. J Food Sci 36:607-610

Bhaskar Reddy GV, Shashi Kumar M,Gupta RS, Kiran M, Kondal Reddy K (2012) Effect of oat flour on quality characteristics of low-fat chicken sausages. J Meat Sci 8(1&2): 8-15

Bhoyar AM, Pandey NK, Anand SK, Verma SS (1996) Development of restructured chicken steaks using texturized soya protein as extender. Indian Food Packer July-August, 15-22

Chandralekha S, Jagadeesh Babu A, Moorthy PRS, Karthikeyan B (2012) Process optimization for the development of value added chicken meat balls. Tamilnadu J Vet Anim Sci 8 (4) 176- 180

Chowdhury J, Kumar S, Keshri RC (1994) Physico-chemical and organoleptic quality of chicken patties incorporating texturized soy. Indian J Poult Sci 29 (2): 204-206

Dushyanthan K, Narendrababu R, Vasanthi C, Venkataramanujan V (2008) Processing of buffalo meat nuggets utilizing different binders. Tamilnadu J Vet Anim Sci 4(2):77-83

Dzudie T, Scher J, Hardy J (2002) Common bean flour as an extender in beef sausages. J Food Eng 52: 143–147

Ei-Mangoli S, Laroia S, Hansen PMT (1996) Flavor and texture characteristics of low fat ground beef patties formulated with whey protein concentrate. Meat Sci 42: 179-193

Gujral HS, Kaur A, Sigh N, Sodhi NS (2002) Effect of liquid whole egg, fat and textured soya protein on the textural and cooking properties of raw and baked patties from goat meat. J Food Eng 53: 377-385

Hongsprabhas P, Barbut S (1999) Effect of preheated whey protein level and salt texture development of poultry meat batters. Food Res Int 32: 145-149

Huda N, Yap HS, Yong LH (2009) Proximate composition, colour, textural profile of Malaysian chicken balls. Pak J Nutr 8:1555-1558

Ikhlas B, Huda N, Noryati I (2011) Chemical composition and physicochemical properties of meatballs prepared from mechanically deboned quail meat using various types of flour Intl J Poult Sci 10: 30-37

Kaya M, Go¨kalp HY (1990) Effect of textured soy protein on the characteristics of koefte. Fleischwirchaft 70: 646–649

Mielnik MB, Aaby K, Rolfsen K, Ellekjaer MR, Nilsson A (2002) Quality of comminuted sausages formulated from mechanically deboned poultry meat. Meat Sci 61: 73-84

Modi VK, Mahendrakar NS, Narasimha Rao D, Sachindra NM (2003) Quality of buffalo meat burger containing legume flours as binders. Meat Sci 66 (1): 143-149

Prasad B, Rashmi M, Ysshoda K, Modi V (2011) Effect of casein and oat flour on physico chemical and oxidative processes of cooked chicken kofta. J Food Proc Pres 35(3): 359–368

Reddy P, Rao TS (1996) Influence of binders and refrigerated storage on the quality characteristics of chicken patties. Indian J Poult Sci 31 (2):110-114

Reddy NSP, Reddy MS, Reddy KS (1999) Influence of inclusion of non-meat extenders in mutton sausages on its quality. Indian Food Packer March-April: 20-21

Serdaroglu M, Turp GY, Abrodimov K (2005) Quality of low-fat meat balls containing legume flours as extenders. Meat Sci 70 (1): 99-105

Tharanathan RN, Mahadevamma S (2003) Grain legumes a boon to human nutrition. Trends Food Sci Technol 14: 507–518

To¨mek SO, Serdarog¢lu M, Go¨nenc¸ayog¢lu D (1988) Soya protein izolatý kullanýmýnýn salam kalitesine etkilerinin arastýrýlmasý. E.U¨. Mu¨hendislik Faku¨ltesidergisi, 1(1): 67–73

Weirbicki E, Tiede MG, Burrell RC (1962) Determination of meat swelling as a method for investigating the water-binding capacity of muscle protein with low water-holding forces.1. The methodology. Die Fleischwirtscnaft 14: 948