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Development and quality evaluation of oat flour incorporated spent hen meat balls

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Abstract
A study was carried out to determine the effect of incorporation of oat flour at 4, 8 and 12% levels on proximate composition and physicochemical characteristics of spent hen meat balls after repeated trials. Among different treatments, meat balls incorporated with 12% oat flour showed significantly (P<0.05) higher moisture percent and crude fibre percent and significantly (P<0.05) lower protein percent and fat percent than rest of the formulations. The percent cooking yield and emulsion stability of meat balls incorporated with 12% oat flour was found to be significantly (P<0.05) higher than the meat balls incorporated with oat flour at 4 and 8% levels. The results showed the significant positive effects of addition of oat flour in spent hen meat balls and oat flour can be incorporated up to a level of 12% with all desirable qualities.

Keywords: cooking yield, emulsion stability, oat flour, proximate composition and spent hen meat balls

Introduction
Meat and meat products are recognized as important source of all essential nutrients and contain high biological value proteins, fatty acids, vitamins, minerals, trace elements and bioactive compounds (Yadav *et al*., 2016) [17]. In spite of all positive effects meat is deficient in complex carbohydrate like dietary fibre (Vendrell-Pascuas *et al*., 2000) [16] which is most essential for human health for control of body weight, reduction of cardiovascular diseases and maintenance of normal physiological and biochemical process (Talukedar *et al*., 2010) [13]. Due to increasing consciousness among consumers about the nutrition and changes in socio economic lifestyle meat consumers are now days demanding food with high fiber and low fat. Incorporation of dietary fiber in meat products has been emphasized a lot due to health benefits of fiber and also as potential fat substitute. Meat products formulated with optimal levels of dietary fibre gain interest in the design of new functional foods along with the increase in product yield (Sandeep *et al.*, 2018) [11]. Among all sources, oatfiber contain more soluble fiber than other cereal grains and also contain more antioxidant which reduce the LDL cholesterol level and reduce the risk of coronary diseases, besides the health benefits, dietary fibre addition also increases the cooking yield prevent cooking loss, enhance water binding capacities and retain flavor in meat products and provides economic a benefits to consumers and producers as well (Reddy *et al*., 2017) [8]. Considering the opportunities existing with incorporation of dietary fibre in spent chicken meat, the present study was undertaken with an effort to understand and optimize the incorporation of oat flour in different levels to produce fibre fortified chicken meat balls.

Materials and Methods
Female layer birds after 72 weeks of age (spent hens) were procured from local farms. Birds were starved for 6 hours before slaughter then slaughtered and dressed in the Department of Livestock Products Technology, CVSC, Rajendranagar as per standard procedures and guidelines Dressed carcasses after post mortem examination were packed in LDPE bags and stored at 4±1 ºC for 12 hours. The dressed carcasses were deboned manually next day and all the visible fat and connective tissue was trimmed off and frozen at -18 ºC until further use. Meat was used for product preparation after partial thawing at 4 ^{0}C for 12-15 hrs. Oat flour and other non-meat ingredients like salt, sugar, binder, red chilli powder, vegetable oil and other ingredients for spice mix were procured from local market from Hyderabad. Condiment mix was prepared by using onion and garlic paste in 3:1 ratio. Six trials were conducted initially to determine the optimum inclusion level of oat flour to be incorporated and further study was

done by addition of lean meat with 3 levels i.e 4, 8 and 12% of oat flour.

Prepartion of Chicken Meat Balls With Oat Flour

Frozen chicken meat was thawed in the refrigerator (4±1°C) and minced using meat mincer (Model: Sirman TC 32 Colorado, Italy) first by 8mm plate followed by 4mm plate. Meat balls were prepared using ingredients as per the recipe presented in Table-1 viz., Control and oat flour incorporated at 4, 8 and 12% levels replacing lean meat. Emulsion was prepared in Bowl Chopper (Model: MADO Garrant MTK 661, Germany) by mixing ingredients in a sequence. Oat flour was added individually at 3 levels viz., 4%, 8% and 12% along with minced meat in bowl chopper and chopped for 30 seconds. Salt, sugar, phosphate, ice were added sequentially and blended for 60 seconds then oil was added and blended for 30-60 sec for emulsion formation. Dry spice mix, chili powder, wet condiment mix and binder were added sequentially and blended for 30 sec in bowl chopper. Then emulsion was made in to round balls and cooked for 20 mins at 80ºC in moist heat to attain the internal temperature of 72^{0}C. After cooking meat balls were cooled to room temperature and chilled under refrigeration for few minutes followed by packing in LDPE pouches (200 Gauge thicknesses) under aerobic packaging for further analysis.

Table 1: Formulations of chicken meat balls with incorporation of oat flour at 4%, 18%, 12% levels.

Ingredients	Treatments			T3
	Control	T1	T2	
Meat (%)	85	81	77	73
Fat (%)	15	15	15	15
Oat Flour (%)	-	4	8	12
Non Meat Ingredients				
Salt %			2	
Sugar%			1	
Binder(wheat flour)%			3	
Dry Spice mix%			1.5	
Wet condiments mix %			4	
Red chilli powder %			0.25	
Polyphosphate (stpp) %			0.3	
Ice flake %			10	

pH

The pH of the emulsion and product was determined by following the method of Trout *et al*. (1992) [15]. After blending 5 gms of sample with 45 ml of distilled water in motor and pestle for one minute.The pH of the suspension is recorded by dipping combined glass electrode of a digital pH meter (Model:Hanna HI 2211) after calibration with three standard buffers pH 4.0, 7.0 and 14.0

Emulsion Stability

Emulsion stability was carried out by adopting method of Townsend *et al*. (1968) with some modifications. About 25 g of raw emulsion was placed in low density polyethylene (LDPE) bags. Bags with weighed samples were sealed and placed in a water bath and cooked at 80 °C for 20 minutes. The bags were removed from water bath, cut open and the cook out fluid drained off and the cooked samples were weighed. Emulsion stability was calculated as percent by dividing final weight with initial emulsion weight

Cooking Yield

The weight of meat balls before and after cooking was recorded. Cooking Yield was calculated as Percentage by obtaining ratio between weight of the sausages after cooking and raw sausage as per the method suggested by Murphy *et al*. (1975).

Proximate Composition

Proximate parameters viz., moisture, protein, fat and ash measurement were done according to the methods described by AOAC (1995) [1] Moisture (oven drying), protein (Kjeldahl distillation), fat (Soxhlet method), crude fiber and ash (muffle furnace) content of both control and treated meat balls were determined by using established procedure as described by AOAC (2000).

Results and Discussion

The developed meat balls were analyzed for both physico chemical properties and proximate composition.Three different levels of oat fibre viz. 4% (T1), 8% (T2) and 12% (T3)) were incorporated and subjected to evaluation.

Physico Chemical Properties

PH

The pH of the emulsion significantly (P<0.05) increased with increase in level of incorporation of oat flour. The pH of cooked product incorporated with 12% oat flour was observed to be higher than the other treatment groups. The results obtained were similar to Talukdar and Sharma (2010) [13] who incorporated chicken meat patties with wheat bran and oat bran. Yılmaz (2005) [20] and (Sandeep *et al.*, 2018) [11] also observed similar variations in chicken meat balls and spent hen nuggets incorporated with wheat bran, respectively.

Emuslion Stablity

Meat balls incorporated with 12% oat flour recorded significantly (P<0.05) higher emulsion stability and lowest was observed in 4% compared to other two formulations which might be due to high functional properties of added flour to entrap the moisture in the emulsion while cooking The results obtained in the study are in agreement with the reports of (Govind *et al.*, 2013) [5] In emu meat sausages with oat flour and (Hughes *et al*., 1997) [7] in frankfurters incorporated with oat fibre.

Cooking Yield

The cooking yields were studied in control T1, T2 and T3 respectively. The higher fiber group had a significantly higher cooking yield than other treatment groups and lowest was observed in control which might be due to excessive fat separation and water release during cooking. There is a possible connection between increasing cooking yield and higher fat retention. The results in the study are in line with observations of (Pinero *et al.*, 2000), (Dawkins *et al*., 1998) and Talukder and Sharma (2010) [13].

Proximate Composition

Results of proximate composition (moisture, protein, fat, ash carbohydrate fiber) of spent chicken meat ball influenced by oat flour were recorded.

Among different treatments, spent hen meat balls incorporated with oat flour at 12% level (T3) showed significantly (P<0.05) higher moisture percent and crude fiber percent and lower Crude Protein percent and Crude fat percent than other treatments and control. Moisture percent of the treated products increased with the increase in the levels

of oat flour and significant effect (P<0.05) was observed at all levels of incorporation, higher moisture percent in the product might be due to water binding properties of added oat flour which would have retained more moisture. The results were in agreement with study of Maheswara Reddy and Vani, (2017) [8] who found significantly higher moisture percent in chicken meat balls incorporated with 15% oat fibre. The higher concentration of insoluble fiber in oats than in meat might be the reason for higher crude fibre percentage on meat balls incorporated with 12% oat flour. Similar observations were made by (Huang *et al*., 2011) [6] and (Dawkins *et al*., 1999) [3]. The significantly lower crude fat percent and crude protein percent of spent hen meat balls incorporated with 12% oat flour might be attributed to lower protein and fat content of oats. The results of present study were similar with findings of Santhi and Kalaikannan (2014) [12] in chicken nuggets and Yang *et al*., (2007, 2009) [19, 18] in pork and duck meat sausages respectively.

Conclusion

The results of this study revealed that chicken meat balls incorporated with oat flour at 12 per cent level had recorded significantly (P<0.05) higher percent cooking yield, higher percent emulsion stability, higher ph, higher per cent moisture, crude fiber and lower per cent crude fat and protein. Based on the present findings, it is concluded that the addition of oats flour at 12 per cent level in chicken meat balls was considered to be optimum for all the desired qualities.

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