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Quality evaluation of chicken meat balls incorporated with hydrated soya chunks

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Abstract
A study was undertaken to determine the effect of incorporation of hydrated soya chunks in Chicken meat balls. Standardized recipe containing Chicken lean meat (85%), vegetable oil (15%) was considered as control. Hydrated soya chunks were incorporated replacing lean meat in chicken meat balls at 5% (T1), 10% (T2) and 15% (T3) levels. The meat balls were evaluated for physicochemical and organoleptic quality. The results revealed that there was significant difference (p>0.05) in pH, emulsion stability and cooking yield. The emulsion pH and cooked product pH was observed to be significantly higher in T3 whereas emulsion stability was significantly lower in T3. Significantly higher cooking yield was found in T3. A 7-point hedonic scale was used to evaluate the sensory characteristics (appearance, flavour, texture and overall acceptance) of the products using a semi-trained taste panel. The scores for appearance, flavour, texture, Juiciness and overall acceptability were found to be significantly (p>0.05) higher in T2 group than Control, T1 and T3 groups. Though the soya chunks at 15% inclusion level showed superior physicochemical properties, they had lower sensory scores, hence the inclusion of hydrated soya chunks at 10% level was considered as optimum and economical for development of protein rich meat products.

Keywords: Chicken meat balls, incorporated, hydrated soya chunks

Introduction
Protein is an essential macronutrient needed by the human body for growth and maintenance. Foods rich in animal protein are meat, fish, eggs, poultry, and dairy products, while plant foods high in protein are mainly legumes, nuts, and grains (Delimaris., 2013) [7]. The increasing cost of animal protein has demanded the need to investigate the use of cheaper and nutritive alternatives in various food formulations. Since soy chunks are rich and cheaper source of plant protein, this would meet the challenges of declining protein availability in the form of soy-based food; such as soy meat combination (Iwe., 2003; Igene *et al.*, 2012; Igene *et al.*, 2006; Igene *et al.*, 2002) [8, 5, 6, 4]. Soy products have been considered as healthy foods - products such as flours, textured soy protein, concentrates and isolates are economical source of food proteins (Hossein., 2011) [3]. The health benefits of soy in meat include prevention of heart diseases, cancer, high blood pressure, diabetes related disease and many others. Soy protein used in the meat production is increasing because of their unique functional characteristics as meat extenders and functional ingredients. Meat extenders are defined as proteins which are non-meat proteins but are usually plant proteins. A wide variety of meat extenders are available for use in emulsion type sausages to improve consistency, emulsifying and water holding capacity. The main value of plant protein in comminuted meat products is to reduce formulation cost. They have the ability to improve viscosity, texture, firmness, moisture, overall yield, fat binding, emulsifying capacity, sensory properties and storage stability (Kinsella., 1979) [9]. Hence, an effort was made to develop chicken meat balls by inclusion of hydrated soya at different levels.

Materials and Methods
Source of Raw material
Broiler birds are purchased from the local market and they were deboned manually in Department of Livestock Products Technology, College of Veterinary Science, Rajendranagar, PVNRTVU, Hyderabad. The dehydrated soya chunks and nonmeat ingredients like salt, vegetable oil spice mix etc were purchased from local supermarket.

Preparation of Emulsion

The broiler meat is first minced in meat mincer using 8mm plate followed by 4mm plate. The meat emulsion was then made by using Bowl chopper. The meat balls are prepared by using the ingredients as per the recipe presented in Table 1.i.e. the hydrated soya chunks were added at 5% (T1), 10% (T2) and 15% (T3) levels replacing the lean meat. The emulsion without addition of soya chunks was considered as control.

Table 1: Formulations of Chicken meat balls with incorporation of different levels of hydrated soya chunks

Ingredients	Control C	Treatments		
		T1	T2	T3
Meat%	85	80	75	70
Fat%	15	15	15	15
Hydrated Soya chunks	-	5	10	15
Non meat ingredients				
Salt%	2			
Sugar%	1			
Polyphosphate (STTP)%	0.3			
Ice flakes%	10			
Dry spice mix%	1.5			
Kashmiri chilly powder%	0.25			
Wet Condiment mix%	4			
Binder (Wheat flour)%	3			

Proximate composition

Percent moisture (oven drying), percent total protein (Kjeldhal method) and percent fat or ether extract (using Soxhlet's apparatus) were determined at various stages of processing of turkey meat ball as per the standard methods (AOAC, 1995) [2].

Percent cooking yield

Percent cooking yield of the product was calculated as follows:

$$\text{Cooking yield \%} = \frac{\text{Cooked weight}}{\text{Raw weight}} \times 100$$

Emulsion stability

About 25 gm of meat ball emulsion was packed in polyethylene bag and heated in a thermostatically controlled water bath at about 80 °C for 20 min. Then the exudate was drained out and caked mass was weighed. The % of caked mass is expressed as emulsion stability.

$$\text{\% Emulsion stability} = \frac{\text{Weight of cooked mass}}{\text{Weight of raw emulsion}} \times 100$$

pH

The pH of meat sample was estimated following the method of (Trout *et al.*, 1992) [17]. 5 grams of sample was blended with 45 ml of distilled water using tissue homogeniser for one minute. The pH was recorded by immersing the glass electrode of digital pH meter into the homogenate.

Sensory Evaluation

A six member experienced panel of judges consisting of scientists and students (postgraduate and doctoral) of Department of Livestock Products Technology, College of veterinary science, Rajendranagar, evaluated the sensory quality such as colour and appearance, flavour, body and texture and overall acceptability using 9-point descriptive scale according to (Rajkumar *et al.*, 2010) [12] with slight modification.

Statistical Analysis

The data were subjected to statistical analysis by applying t-test for unequal variances using Statistical Package for Social Sciences (SPSS), the 25th version (n=6). Differences between means were tested using Duncan's (1951) multiple comparison test and the significance was set at $p<0.05$.

Results and Discussion

Proximate composition (Moisture, Crude Protein and Ether extract) of chicken meat balls incorporated with 5%, 10% and 15% hydrated soya chunks was presented in Table 2. Moisture Percent of Control, T1, T2 and T3 were 60.44±0.33, 61.82±0.45, 62.42±0.62 and 63.82±0.45 respectively. The higher moisture content in treatment groups than control might be due to hydration of soya chunks prior and addition of soaked soya chunks to the meat during the emulsion preparation. The crude protein content was found to significantly higher ($p<0.05$) in T3 (15%) 18.96±0.16 than Control (17.34±0.22), T1 (5%)-17.86±0.11 and T2 (10%)-18.12±0.15 which might be due to addition of higher percentage of protein rich hydrated soya chunks. The fat percent was observed to be lower in T3 (15%)-10.71±0.14 than control, T1 and T2. This might be attributed to lower fat content and higher moisture and protein content in soya chunks which were used as meat extenders. The results obtained were in agreement with (Ahmad *et al.*, 2010 and Sushma *et al.*, 2020) [1, 13].

Table 2: Effect of incorporation of different levels of hydrated soya chunks on Proximate composition of Chicken meat balls

Parameters	Control C	Treatments T1	Treatments T2	Treatments T3
Moisture (%)	60.44±0.33	61.82±0.45	62.44±0.17	63.82±0.10
Crude Protein (%)	17.34±0.33^{c}	17.86±0.15^{c}	18.12±0.06^{b}	18.96±0.22^{a}
Ether Extract (%)	12.63±0.13^{c}	11.89±0.10^{b}	11.22±0.28^{b}	10.71±0.15^{c}

Means with different superscripts in the same row differed significantly ($p<0.05$)

The pH of emulsion and cooked product incorporated with 15% of hydrated soya chunks (6.75±0.03 and 6.83±0.07) were higher than control, T1 and T2 (Table 3). The increase in product pH compared to emulsion pH might be due to the cooking (Polanne *et al.*, 2001) [10]. The increase in pH might be due to addition of higher quantity of protein rich hydrated soya chunks. Increasing trend was observed for cooking yield of meat balls made by using different levels of hydrated soya (Table 3). Significantly higher cooking yield was observed in T3 (95.42±0.38). Addition of higher amount of extenders into T3 would have contributed to higher cooking yield in T3. The emulsion stability of chicken meat balls differed significantly ($p>0.05$) due to incorporation of hydrated soya chunks. Significantly ($p>0.05$) lower emulsion stability was observed in T3 which might be due to higher pH of T3 which further reduced the stability of emulsion.

Table 3: Effect of incorporation of different levels of hydrated soya chunks on Physico chemical properties of Chicken meat balls

Parameters	Control C	Treatments T1	Treatments T2	Treatments T3
Emulsion pH	6.10±0.02	6.45±0.03	6.62±0.03	6.75±0.03
Product pH	6.25±0.07	6.51±0.04	6.74±0.03	6.83±0.08
Emulsion Stability (%)	95.22±0.58^{a}	94.58±0.50^{a}	92.61±0.34^{b}	90.81±0.39^{c}
Cooking Yield (%)	90.30±0.40^{d}	92.45±0.36^{c}	93.76±0.33^{b}	95.42±0.38^{a}

Means with different superscripts in the same row differed significantly (p<0.05)

The sensory scores of various formulations control, T1, T2 and T3 was shown in Table 4. Appearance, Flavour, Texture, Juiciness and overall acceptability and taste had higher score as a result of incorporation of hydrated soya chunks. The higher scores may be due to the addition of extenders which improved the texture of chicken meat balls (Todd *et al.*, 1989; Pszcola 1991., Troutt *et al.*, 1992 and Thebaudin *et al.*, 1997) [15, 11, 16, 14]. The significantly (p>0.05) higher sensory scores were observed in T2 (10% of hydrated soya chunks). Similar findings were reported by (Ahmad *et al.*, 2010 and Sushma *et al.*, 2020) [1, 13]. It can be concluded that the incorporation of hydrated soya chunks at 10% level can improve the physico chemical and sensory quality of chicken meat balls than the control without extender.

Table 4: Effect of incorporation of different levels of hydrated soya chunks on organoleptic quality of Chicken meat balls

Parameters	Control C	Treatments T1	Treatments T2	Treatments T3
Appearance	7.23±0.01	7.40±0.05	8.12±0.12	7.06±0.08
Flavour	7.29±0.07	7.44±0.18	7.52±0.16	6.33±0.06
Texture	7.50±0.11	7.87±0.04	7.93±0.13	6.60±0.05
Juiciness	7.11±0.12	7.48±0.08	7.87±0.11	6.92±0.07
Overall acceptability	7.50±0.15	7.83±0.07	7.92±0.12	7.90±0.13

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