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Development and Quality Assessment of Fiber Enriched Nuggets of Kadaknath Chicken

Shubham Uikey and Narendra Nayak*

Department of Livestock Products Technology, College of Veterinary Science & A.H., Mhow, Indore-453446

ABSTRACT

The present investigation was carried out with the prime objective of increasing fiber content by incorporating gram hulls. Upon conducting various trials, on the basis of sensory attributes three best levels were selected. Efficacy of gram hulls at three different selected levels (T1-4%, T2-6% & T3-8%) was assessed to increase the fiber content in kadaknath chicken nuggets. The pH value for control was significantly ($P<0.05$) higher as compared to treatment. Moisture content decreased gradually and showed a significant ($P<0.05$) difference at 6 % and 8 % incorporation of gram hulls. The fiber content in kadaknath chicken nuggets was increased significantly ($P<0.05$) with the increasing level of gram hulls. Moisture retention of gram hulls incorporated kadaknath chicken nuggets also differ significantly ($P<0.05$). Hardness value was increased gradually with the increasing level of gram hulls and become significant ($P<0.05$) at T-3. There was a significant ($P<0.05$) difference between control and T-3 in the adhesive force as well as cohesiveness value of high fiber kadaknath chicken nuggets. A non–significant ($P>0.05$) lower gumminess value was recorded for the product prepared with 4 % gram hulls as compared to control. The mean score value for overall acceptability showed that the score for T-3 was significantly ($P<0.05$) lower compared to control. However, score for T-2 was comparable to control. Hence, T-2 (6% gram hulls) was finally selected as optimum for incorporation to develop fiber enriched kadaknath chicken nuggets.

Keywords: *Kadaknath nuggets, Gram hulls, Fiber enriched, Functional food*

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INTRODUCTION

Kadaknath is only Black Meat Chicken (B.M.C.) Breed of India. It is a native bird of Madhya Pradesh. The bird is very popular locally mainly due to its adaptability to the local environment, disease resistance, tasty meat quality, texture and flavour ((Rao and Thomas, 1984). Though the flesh of this breed is black, it is considered not only a delicacy of distinctive taste, but also of medicinal value by tribals / adivasies living in Jhabua District of (M.P.). However, scientific validation is still required. . Meat is an important source of protein and essential nutrients. However, a sector of the population perceives meat as a food that is detrimental to their health because it contains high levels of saturated fat and little or no fiber or calcium (Oliveira et al 2011). Growing understanding of the relationship between diet and health is leading to new insights into the effect of food ingredients on physiological function and health, inducing increased consumer demand for healthy, nutritious foods with additional health promoting functions. Over the last several decades, meat products have come under increasing scrutiny by medical, nutritional and consumer groups because of the associations established between their consumption (Low fat, cholesterol and high fibre) and the risk of some of the major degenerative and chronic diseases like heart disease, hypertension, obesity and colon cancer.(Chan and Giovannucci, 2010; Goldhaber, 2010). A diet high in fibre usually advocates a healthier life-style (Kritchevsky, 2000) and fibre intake can be viewed as a marker of healthy diet. On the other hand, meat as such does not contain any dietary fibre. Image of meat as a healthy food has diminished in recent years which can be improved by incorporating plant based dietary fiber. Gam hull is a byproduct and is easily procured from local market on very low cost basis. It is a very good source of fibre (44.4%). Chunies of Bengal gram and red gram contain moderate amount of protein and high level of crude fibre (Rasco et al., 1989).

Several scientists throughout the globe have explored the possibility to increase to develop functional meat products by increasing fiber content to improve the health of the consumer. However, there is a wide gap in research and development of such products in Indian subcontinent. Therefore, incorporation of gram hulls in meat products may improve functionality and provide various health benefits.

MATERIALS AND METHODS

Meat and additives: Kadaknath chicken of 4-5 months with approximately 1.5 kg of weight was procured from Department of Poultry Science of the college, slaughtered according to traditional halal method. The meat was, packed in low-density polyethylene (LDPE) bags and brought to the laboratory within 20 min. The meat was deboned, trimmed-off separable fat and connective tissue. The samples were kept for conditioning in a refrigerator at 4 ± 1 oC for 6–8 h and then frozen at -18 oC till further use. The samples were used after partial thawing for 15 h at 4 oC. Various flours, condiments (onion, ginger, and garlic), oil, salt, gram hulls were purchased from local market. The ingredients (Anise, Black pepper, Capsicum, Caraway, and Cardamom, Cloves, Cinnamon, Cumin, Dry ginger, Turmeric and Coriander) in desired ratio were procured from local market, dried at 45±2oC for 2 hours followed by grinding and sieving through 100 mesh. The spice mix was stored in low density polyethylene bags and used as per requirement. All the chemicals and media used in the study were of analytical grade and obtained from standard firm.

Processing: Kadaknath Chicken meat was partially thawed overnight, cut into small cubes and double minced in an electrolux mincer. Meat emulsion was prepared in a bowl chopper (Seydelmann K20, Ras, Germany). Pre-weighed quantity of minced chicken meat, salt, and sodium tripolyphosphate, were added and chopped for about 2-3 minutes. It was again chopped for 2 minutes after the addition of ice flakes. Refined vegetable oil was slowly incorporated while chopping till it was completely dispersed in the better. Condiments paste, dry spices

*Corresponding author E-mail address : nayaknarendra2@rediffmail.com
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mix, refined flour and other ingredients were added. Chopping was continued till uniform dispersion of all the ingredients and desired consistency of the emulsion was achieved. The emulsion were prepared in four different groups as per given formulation (Table 1). Weighed quantity of emulsion was taken and fills in stainless steel mould. Mould was covered with lid and tied with thread and steam cooked for 35 minutes. Kadaknath chicken meat blocks so obtained were sliced and cut into pieces to get nuggets. The nuggets were packed in low-density polyethylene pouches and stored at refrigerated temperature (4±1°C).

Table 1: Formulation for incorporation of gram hulls for the development of high fiber kadaknath chicken nuggets.

Ingredients	Control	T1 (4%)	T2 (6%)	T3 (8%)
Meat (%)	75.0	71.0	69.0	67.0
Gram Hull (%)	00	4.0	6.0	8.0
Refined Flour (%)	4.0	4.0	4.0	4.0
Vegetable oil (%)	5.0	5.0	5.0	5.0
Condiments (%)	5.0	5.0	5.0	5.0
Ice – Flakes (%)	7.0	7.0	7.0	7.0
Spices (%)	2.0	2.0	2.0	2.0
Salt (%)	1.6	1.6	1.6	1.6
STPP (%)	0.4	0.4	0.4	0.4
Total (%)	100	100	100	100

C (control) – Kadaknath chicken nuggets without gram hulls, T-1- Kadaknath chicken nuggets with 4% gram hulls; T-2- Kadaknath chicken nuggets with 6% gram hulls and T-3 Kadaknath chicken nuggets with 8% gram hulls

Packaging materials: Low density Polyethylene (LDPE) bags of 250 gauge thickness were sourced from local market for packaging and were pre-sterilized by exposing to U.V. light for 30 minutes before use.

Analysis of product: The developed fiber enriched kadaknath chicken nuggets were evaluated for various physic-chemical properties as per standard procedure. pH was determined by using digital pH meter (WTW, Germany, model pH 330i) by immersing the spear type combination electrode (Sentix®, Germany) directly into minced meat sample. Prior to measurement, pH meter was calibrated every time as per the manufacturer's instructions using known buffers of pH 7.0 and 4.01. Reading was taken twice for each sample and average of reading was taken as pH of sample.

The proximate parameter like moisture, protein, fat, fiber and ash contents was evaluated as per AOAC (1995). Moisture Protein ratio was calculated by ratio of the moisture and protein content in the sample. Moisture retention value represents the amount of moisture retained in the cooked product per 100 g of sample and was determined according to equation by El-Magoli et al. (1996). Fat retention was calculated based on a modified method of Murphy et al. (1975).Textural properties of kadanath chicken nuggets were evaluated using the texturometer (stable micro system TA.XT-2i-25) as per Bourne, (1978). Sensory evaluation was carried out by using 8-point objective scale (Keeton et al., 1983), where 8 denoted extremely desirable and 1 denoted extremely undesirable.

Statistical analysis: The data obtained in the study on various parameters were statistically analyzed on 'SPSS-16.0' software package as per standard methods of Snedecor and Cochran (1995). Duplicate samples were drawn for each parameter and the experiment was replicated thrice (n=6). Sensory evaluation was performed by a panel of seven member judges three times, so total observations being 21 (n=21) Data were subjected to one way analysis of variance, homogeneity test and Duncan's Multiple Range Test (DMRT) for comparing the means to find the effects between samples.

RESULTS AND DISCUSSION

Physico-chemical properties: The mean value for various physico- chemical properties of high fiber kadaknath chicken nuggets incorporated with different level of gram hulls are presented in Table 02. The pH values for control were significantly ($P<0.05$) higher as compare to treatment products. However, no significant ($P>0.05$) difference among the treatments was noticed. Verma *et al.* (2010) also reported higher pH value in control chicken nuggets compare to treatments. There were no significant ($P>0.05$) difference in emulsion stability and cooking yield. However, the gradual declining trends in the cooking yield as well as emulsion stability were recorded with increasing level of gram hulls. This might be due to lowering the concentration of extracted protein involved in formation of emulsion matrix and replacement of lean meat by gram hulls. The mean value of moisture content decreased gradually and showed a significant ($P<0.05$) difference at 6% and 8% incorporation of gram hulls. This might be due to higher dry matter percentage as well as poor emulsion stability in treatment products which leads to lower water binding. Verma *et al.* (2010) also reported similar pattern in moisture content in designer chicken nuggets. There were no significant ($P>0.05$) difference in protein and fat content among the different treatments. However, they were gradually decreased from control to T-3. This might be due to replacement of lean meat by gram hulls in the formulation, as the compositional value of gram hulls indicated lower fat and protein content 1.2% and 24.6% respectively. Similar pattern of decreasing protein and fat content was also observed by Verma *et al.* (2010).

The fiber content in kadaknath chicken nuggets was increased significantly ($P<0.05$) with the increasing level of gram hulls from control to T-3. This might be due to compositional value of added gram hulls as it contains 45.49% crude fibre. Swain *et al.* (2016) also reported 40.68% fibre content in bengal gram chunni. Goswami *et al.* (2017) also reported increasing trend in fiber content of mango peel incorporated carabeef cookies. Results clearly indicated that ash content was significantly higher in treatments as compared to control. However, there were no significant ($P>0.05$) differences among the treatments. A marginal decrease in the moisture protein ratio was recorded with the increasing level of gram hulls. This might be due to obvious higher moisture content and similar protein content in the respective level of formulation. Moisture retention of gram hulls incorporated kadaknath chicken nuggets was gradually decreased from control to T-2. However, a significant ($P<0.05$) difference at T-3 compared to control was recorded. This might be due to lower emulsion stability in the gram hulls incorporated kadaknath chicken nuggets.

Table 2: Effect of incorporation of different levels of gram hulls on the physico – chemical properties of kadaknath chicken nuggets

Parameters	C	T1 (4%)	T2 (6%)	T3 (8%)
pH	6.01±0.00^{b}	5.81±0.00^{a}	5.80±0.04^{a}	5.80±0.01^{a}
Emulsion stability (%)	92.44±0.76	91.17±0.89	91.12±0.67	90.64±0.50
Cooking yield (%)	93.01±0.91	91.98±0.67	92.70±1.48	91.85±1.21
Moisture (%)	64.83±1.14^{b}	62.40±1.00^{ab}	61.76±1.00^{ab}	60.42±0.84^{a}
Protein (%)	26.94±0.45	26.45±0.63	26.12±0.40	25.74±0.14
Fat (%)	6.33±0.25	6.15±0.28	6.11±0.12	6.07±0.44
Fibre (%)	0.83±0.08^{a}	2.55±0.06^{b}	3.76±0.09^{c}	4.72±0.09^{d}
Ash (%)	2.41±0.53^{a}	3.39±0.06^{b}	3.55±0.10^{b}	3.47±0.08^{b}
Moisture–Protein ratio	2.41±0.05	2.36±0.07	2.36±0.02	2.35±0.04
Moisture retention (%)	60.34±1.35^{b}	57.40±1.03^{ab}	57.31±1.72^{ab}	55.49±0.97^{a}

Means with different superscripts differ significantly within row at P<0.05. n=5

Texture profile analysis: The mean value for texture profile analysis of high fiber kadaknath chicken nuggets incorporated with different levels of gram hulls are presented in Table 03. The hardness value was increased gradually with the increasing level of gram hulls and become significant (P<0.05) at T-3. However, there were no significant (P>0.05) difference between control and T-1and T-2. Yadav et al. (2016) also reported increasing hardness value with the increasing level of bran in chicken sausages. There was a significant (P<0.05) difference between control and T-3 in the adhesive force of high fiber kadaknath chicken nuggets. However, a non-significant (P>0.05) declining trend was noticed from control to T-2. Verma et al. (2012) also reported a non-significant (P>0.05) difference in the adhesiveness of low fat chicken nuggets incorporated with chick pea hull flour. Cohesiveness value showed a non–significant (P>0.05) declining trend with the increasing level of gram hulls from control to T-2. Thereafter, at the level of T-3 indicated a significant (P<0.05) difference compare to other group of treatment. Lin and Lin (2004) reported a decrease in cohesiveness value with the increasing level of bacterial cellulose (Nata) in Chinese style meat balls. There was a non-significant (P>0.05) lower gumminess value was recorded for the product prepared with 4% gram hulls as compared to control. Further the gumminess value in the treatment increased as the level of gram hulls in the product is increased. Verma et al. (2012) observed a similar trend in low fat chicken nuggets incorporated with chick pea hull flour. Grigumo-Mriguel et al. (1999) reported an increase in gumminess value of low fat high fiber frankfurters as the concentration of peach fiber increased.

Table 3: Effect of incorporation of different levels of gram hulls on the texture profile of kadaknath chicken nuggets.

Parameters	C	T1 (4%)	T2 (6%)	T3 (8%)
Hardness (N/cm2)	19.41 ± 0.06^{a}	19.95 ± 0.74^{ab}	20.50 ± 0.95^{ab}	22.14 ± 1.05^{b}
Adhesive force (Ns/g sec)	-0.625±0.002^{b}	-0.620±0.001^{ab}	-0.620±0.001^{ab}	-0.610±0.001^{a}
Cohesiveness (ratio)	0.376 ± 0.002^{b}	0.375 ± 0.002^{b}	0.371±0.003^{b}	0.358± 0.004^{a}
Gumminess (N/cm2)	8.218 ± 0.159	7.743 ± 0.157	7.893 ± 0.021	8.206 ± 0.221

Means bearing different superscripts (a, b, c) in a row differ significantly (P<0.05)

Sensory evaluation: The mean score for general appearance, flavor, texture, mouth coating, saltiness, juiciness and overall acceptability of high fiber kadaknath chicken nuggets incorporated with different levels of gram hulls are presented in Table 4. Score for general appearance indicated non–significant (P>0.05) difference among the treatments compare to control. However, marginal difference in the color score was noticed. This might be due to inherent color of kadaknath chicken meat. Nuggets prepared by different levels of gram hulls had lower flavor score than the control. Nuggets with 8% gram hulls indicated significantly (P<0.05) lower flavor score compare to control. Reduction in the flavor with increasing level of gram hulls might be due to dilution of meaty flavor. Mehta et al. (2013) reported lower flavor score for husk and rice bran added chicken meat rolls and patties. The mean texture score of high fiber kadaknath chicken nuggets was gradually decreased with the increasing level of gram hulls. Score of control product was significantly (P<0.05) higher as compared to treatment with 8 % gram hulls. Verma et al. (2012) reported a decreasing trend in the texture score of low fat chicken nuggets with increasing level of chick pea hull flour. There were no significant (P>0.05) difference in the mouth coating, saltiness as well as juiciness score between control and treatment. However, the marginal reductions in the scores were noticed with the increasing level of gram hulls. Lower juiciness score with increasing level of gram hulls could be due to graininess perceived by sensory panelists (Claws and Hunt, 1991) as well as lower moisture percentage in the gram hulls incorporated kadaknath chicken nuggets. Verma et al. (2012) recorded lower juiciness score in chick pea added chicken nuggets. Yilmaz and Daglioglu (2003) also reported decrease in juiciness score with increased level of oat bran in meat balls.

Table 4: Effect of incorporation of different levels of gram hulls on the sensory attributes of kadaknath chicken nuggets.

Parameters	C	T1 (4%)	T2 (6%)	T3 (8%)
General appearance	7.04±0.18	6.96±0.12	6.92±0.16	6.88±0.16
Flavor	7.08±0.14b	7.04±0.20b	7.00±0.21b	6.71±0.14a
Texture	7.09±0.14b	6.90±0.15b	6.85±0.15b	6.61±0.14a
Mouth coating	6.95±0.20	6.85±0.17	6.80±0.17	6.66±0.17
Saltiness	6.52±0.29	6.47±0.14	6.52±0.14	6.47±0.24
Juiciness	7.09±0.19	7.04±0.20	7.00±0.20	6.52±0.22
Overall acceptability	7.14±0.17b	7.14±0.15b	7.09±0.11b	6.71±0.14a

Means bearing different superscripts (a, b, c) in a row differ significantly (P<0.05)

The mean score value for overall acceptability showed that the score for T-3 was significantly (P<0.05) lower compared to control. However, score of T-1 and T-2 either comparable or slightly lower than control. Comparatively lower flavor and texture scores of treatment could be the factors that have resulted to lower rating by the sensory panelists. These findings are in agreement with the observation recorded by Verma et al. (2012) in chicken nuggets; Mehta et al. (2013) in chicken rolls and patties and Yilmaz (2004) in meat balls.

CONCLUSION

The developed product was assessed for physico- chemical, textural properties and sensory attributes. The fiber and ash contents were significantly increased with the addition of gram hulls. Sensory attributes of kadaknath chicken nuggets with 6 % gram hulls indicated comparable scores compared to control .Therefore, it is concluded that up to 6 % gram hulls may be incorporated for the development of fiber enriched kadaknath chicken nuggets without affecting the quality and sensory attributes of the products.

COMPETING INTERESTS : No

ETHICS STATEMENT : Not Applicable

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