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Research Note

Potential of Green Gram Flour as an Enrobing Material for Papaya-Pulp Enriched Chicken Nuggets

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ABSTRACT

A study was conducted to evaluate the possibility of utilization of green gram flour (GGF) as an enrobing material for papaya pulp-enriched chicken nuggets. GGF was used at two different levels in the batter mix viz. 25 % (w/w) and 35 % (w/w) separately and analyzed for various quality parameters. The products developed were assessed for various physicochemical, proximate and sensory parameters. A significant effect ($p< 0.05$) was observed on cooking yield, moisture percent, ether extract, ash content and crude fiber content of the products. Significantly ($p<0.05$) higher cooking yield, ether extract, ash and crude fiber content was observed for the products enrobed with 35 % GGF in comparison to nuggets enrobed with 25 % (w/w) GGF. Non-significant ($p> 0.05$) change was observed in colour and appearance, juiciness and flavour, however, a significant ($p< 0.05$) decrease was noted in the scores of texture and overall acceptability with increase in the level of green gram flour in the batter mix. Based on various quality parameters, 25 % level of GGF was optimized as best for enrobing of papaya pulp-enriched chicken nuggets.

Keywords : *Chicken sausages, Emulsion pH, Hurdle technology, Textured soya protein*

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Enrobing is the process of making "further processed products" by applying edible coating to the products (Ahamed *et al.* 2007). It is a process in which foods are traditionally coated with edible coating materials in the form of batter to provide the processors an opportunity to prepare value added products (Raut *et al.* 2011). These edible coatings are thin layers of edible materials applied on or even within foods by immersing, brushing, spraying or wrapping that offers a selective barrier against the transmission of gases, vapours and solutes while also offering mechanical protection (Jairath and Chatli 2013). Enrobing brings several advantages to meat products such as value addition, versatility to consumers and improvement of nutritive value as well as eating and microbial qualities of the products (Ahamed *et al.* 2007). By inhibiting water loss and controlling rate of oxygen and carbon dioxide migration, enrobing can retain quality and extend shelf life. Enrobing can also be used to retard the loss of volatile flavour and aroma compounds and retard changes in textural properties (Biswas *et al.* 2003). Besides providing an opportunity to prepare value added products at a low cost, it also improves food texture, flavour, aesthetic appeal, weight and volume (Xue and Ngadi 2007). It gives more pleasure on eating and produces more desirable appearance and colour besides improving the juiciness and tenderness of the product.

Although, attempts have been made in the past to enrobe the product by using cheaper coating material viz. pectin and bengal gram (Chidanandaiah and Keshri 2007), bengal gram and rice flour (Chidanandaiah and Keshri 2006), however, no information is available regarding the use of green gram flour as an enrobing material in meat products. Further, the application of enrobing and edible coatings or films on precooked meat products has not been as extensively studied as their applications on fresh and frozen meat products (Biswas *et al.* 2003).Information on edible-food coatings is found mostly in the patent literature and in other publications where experimental details and quantitative results are often lacking. To exploit the beneficial effect of green gram flour as a coating to improve the quality of meat products is highly justifiable. Thus, the present study was envisaged to attempt the still inconclusive studies on the utilization of green gram flour as an enrobing material for meat products. A study was designed to incorporate green gram flour at two different levels in the batter mix viz. 25% (w/w) and 35% (w/w) as an enrobing material for papaya pulp-enriched chicken nuggets and analyzed for various quality parameters.

Chicken meat: Birds were procured from the local market of Jammu and were slaughtered by Halal method. The carcasses were deboned manually and the deboned meat was packed in low density polyethylene pouches and frozen at -18°C until use. The meat was thawed in refrigerator for overnight (4 ± 1°C) before use.

Papaya pulp: Preliminary trials were conducted by incorporating different levels of papaya pulp (6, 12 and 18 %)

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and on the basis of sensory attributes, 6 % level was selected as best. Green papaya procured from local market was peeled, cut into smaller pieces and ground to the consistency of a paste in a mixer. The papaya pulp was heated to a temperature of 100°C for 10 min to inactivate papain as it was adversely affecting the texture of the product.

Spices mix, condiments and fat: The spice mix used for preparation of the chicken nuggets was standardized and prepared in the laboratory. Condiments used in the study were onion, garlic and ginger paste in a ratio of 3:2:1. Refined cottonseed oil (*Shreej)* was purchased from local market and used in the preparation of product.

Method of preparation of chicken nuggets: The standardized formulation for emulsion contained lean meat 69.0 %, vegetable oil 8 %, water 6 %, condiment mixture 4 %, refined wheat flour 5 %, egg liquid 3.5 %, spice mix 2 %, salt 1.7 %, monosodium glutamate 0.5 %, sodium tri-polyphosphate 0.3 % and sodium nitrite 120 ppm. The papaya pulp replaced the lean meat in the formulation and was added along with egg liquid, condiments, spices and refined wheat flour during emulsion formation. Meat emulsion was stuffed into stainless steel moulds and subjected to pressure cooking (121°C at 15 lb) for 30 ± 2 min.

Enrobing: Two types of batter mix (Table 1) were prepared for enrobing of chicken nuggets by incorporating two different levels of green gram flour (GGF) viz. 25 % (w/w) and 35 % (w/w).GGF was mixed with carboxymethyl cellulose (1 %), common salt (1.5 %), spice mix (2 %) and glycerol (2 %) in a glass tray. Water was added slowly with intermittent mixing and the batter mix was blended in a mixer for 2 min to attain a uniform consistency. Batter mix was stirred properly and the nuggets were dipped into it and fried in refined cotton seed oil for 5 min at 175 ± 2ºC. The enrobed nuggets were cooled and analyzed for various parameters.

Table1: Formulation of batter mix

Ingredients (%)	**Flour level I**	**Flour level II**
Green gram flour	25	35
Added water	68.5	58.5
Common salt	1.5	1.5
Spice mix	2.0	2.0
Glycerol	2.0	2.0
Carboxymethyl cellulose	1.0	1.0

Analytical procedures

pH: The pH of cooked products was determined by the method of Keller *et al.* (1974).

Proximate composition: The proximate composition of the products was determined as per the standard methods of AOAC (1995).

Cooking yield: The cooking yield of enrobed nuggets was recorded before and after frying. The yield was calculated and expressed as percentage.

Sensory evaluation: The sensory evaluation of the samples was carried for various attributes namely appearance and colour, flavour, juiciness, texture and overall acceptability by a panel of seven trained members composed of scientists and research scholars of the division based on a 8-point hedonic scale, wherein 8 denoted "extremely desirable" and 1 denoted "extremely undesirable" (Keeton 1983).

Statistical analysis

Means and standard errors were calculated for different parameters. Data obtained in the study was analysed statistically on 'SPSS-16.0' software package as per standard methods (Snedecor and Cochran 1997). Duplicate samples were drawn for each parameter and the experiment was replicated three times (n=6). Means for various parameters were analyzed using t-test at the 5% significance level to find the difference between treatments.

Physicochemical parameters

The mean values of various physicochemical parameters of the papaya-pulp enriched chicken nuggets enrobed with green gram flour are presented in Table 2.

pH: Non-significant ($p>0.05$) difference was observed in the pH of the products enrobed with two different levels of green gram flour. This could be due to the buffering capacity of enrobing materials. Similar findings were also observed by Raut *et al.* (2011) who observed no change in the pH of chicken patties enrobed with different levels of Bengal gram flour (BGF). Biswas *et al.* (2003) also reported no change in pH of pork patties enrobed with BGF.

Cooking yield: A significant ($p<0.05$) increase was observed in the cooking yield with increase in levels of green gram flour in the batter mix. The nuggets enrobed with 35 % GGF (w/w) had higher cooking yield. The batter consistency being used is an important factor which influences the adherence of coating that ultimately results in higher or lower cooking yield of the product. Biswas *et al*. (2003) also reported that higher cooking yield relates to adhesion of batter mix on products as good adhesion improves the cooking yield. Furthermore, starch granules present in flours has moisture absorption properties as they swell by taking moisture from batter mix at the time of heating and thereby increase cooking yield (Biswas *et al*. 2003). These findings are in agreement with Raut *et al.* (2011) who observed a similar result in the cooking yield of chicken patties enrobed with BGF.

Proximate parameters: The moisture content was significantly ($p<0.05$) higher in the nuggets enrobed with 25 % green gram flour (w/w) in comparison to the products enrobed with 35 % level. The lower moisture content of the products enrobed with 35 % level can be attributed to more loss of moisture during deep frying of nuggets. The batter consistency is an important factor which influences the adherence of coating that may affect the moisture barrier properties which might have affected oozing out of moisture during frying. Similar findings were also observed by Raut *et al*. (2011) who also reported similar loss of moisture in chicken patties enrobed with BGF. Non-significant ($p>0.05$) difference was observed in the crude protein content of the products enrobed with two different levels of GGF. The ether extract, ash and crude fiber content was significantly ($p<0.05$) higher in the nuggets enrobed with 35 % green gram flour (w/w). Higher ether extract might be due to absorption of more fat during frying by the enrobing material. The higher ash and crude fiber content may be attributed to higher ash and fiber content of the flour. Non-significant ($p>0.05$) difference was observed in the coating thickness of the products.

Sensory quality: The mean values of various sensory parameters of the papaya-pulp enriched chicken nuggets enrobed with green gram flour are presented in Table 3. Non-significant ($p>0.05$) difference was observed in the scores for colour and appearance, flavour and juiciness of the products enrobed with two different levels of green gram flour. Flavour of the products enrobed with 25 % green gram flour showed non-significantly ($p>0.05$) higher scores than 35 % level.

The mean scores of the texture of the products also decreased significantly ($p<0.05$) with increase in the levels of the flour in the batter mix. Improved flavour and texture with enrobing using 25 % level might be due to prevention of leaching of flavour components and retention of more moisture during deep fat frying (Raut *et al*. 2011; Chidanandaiah and Keshri 2006).The solid to water ratio of batter has an important bearing on the quality since it influences the adherence of batter while dipping raw nuggets. The overall acceptability of the products decreased significantly ($p<0.05$) with increase in the level of the flour in the batter mix. The decrease in the overall acceptability scores at 35% level might be attributed to the interaction of flour level and water in the batter mix. Enrobing improves the product sensory quality when added at desired consistencies (Raut *et al.* 2011). Chidanandaiah and Keshri (2006) and Raut *et al.* (2011) also reported similar findings.

Table 2: Effect of green gram flour as enrobing material on the quality characteristics of papaya-pulp enriched chicken nuggets (Mean ± SE)[*]

Parameters	Percentage of flour (W/W)	
	25% Green gram flour	35% Green gram flour
pH	6.41 ± 0.02	6.38 ± 0.03
Cooking yield (%)	88.64 ± 0.12^a	89.84 ± 0.08^b
Moisture (%)	53.26 ± 0.13^b	52.62 ± 0.15^a
Crude protein (%)	16.23 ± 0.26	17.00 ± 0.20
Ether extract (%)	15.60 ± 0.12^a	16.36 ± 0.16^b
Ash (%)	3.09 ± 0.03^a	3.24 ± 0.05^b
Crude fiber (%)	0.80 ± 0.03^a	1.25 ± 0.03^b
Coating thickness (cm)	0.13 ± 0.01	0.17 ±0.01

[*]Mean ± SE with different superscripts in a row differs significantly ($p<0.05$). n = 6 for each treatment

Table 3: Effect of green gram flour as enrobing material on the sensory attributes of papaya-pulp enriched chicken nuggets (Mean ± SE)[*]

Parameters	Percentage of flour (W/W)	
	25% Green gram flour	35% Green gram flour
Colour and appearance	7.09 ± 0.14	6.88 ± 0.13
Flavour	7.13 ± 0.14	6.86 ± 0.19
Juiciness	6.79 ± 0.09	7.12 ± 0.16
Texture	7.09 ± 0.16^b	6.30 ± 0.21^a
Overall acceptability	7.10 ± 0.20^b	6.39 ± 0.23^a

[*]Mean ± SE with different superscripts in a row differs significantly ($p<0.05$)
n = 21 for each treatment

It was conclude that incorporation of 25 % green gram flour in the batter mix for enrobing of papaya-pulp enriched nuggets resulted in higher sensory quality. Thus, incorporation of 25 % green gram flour in the batter mix is optimum for preparation of enrobed chicken nuggets.

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