

Research Paper

Effect of Carrot and Radish Powder on Proximate, Sensory and Physico-Chemical Characteristics of Chicken Nuggets

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ABSTRACT

Meat being the fastest growing industry in India has a tremendous scope for further development when it comes to preparing the ready to eat meat products with high nutrition, high fiber and low cholesterol content. Adding the non meat ingredients like vegetables in meat product will surely enhance the overall quality of meat product. The present study was envisaged to evaluate the effect of carrot and radish powder on proximate, physico- chemical and sensory characteristics of chicken nuggets. Chicken nuggets were prepared with addition of 4, 8 and 12% carrot powder and radish powder and the nuggets were compared with control group for various parameters like proximate composition, physico- chemical characteristics and sensory attributes. It was observed from the study that the moisture percentage increased with addition of carrot powder while decreased when radish powder was added in it. Protein and fat content decreased with addition of carrot and radish powder. Ash and moisture: protein ratio also increased with addition of carrot and radish powder. Cooking yield, moisture retention, and fat retention increased significantly with increase in carrot and radish powder incorporation. With increased carrot powder and radish powder incorporation the sensory score decreased but a non significant difference is observed between 4 and 8% carrot powder and radish powder incorporated chicken nuggets. The present study proves that 8% carrot and 8% radish powder can be incorporated effectively in chicken nuggets to enhance its nutritive and textural properties which is comparable to control group of chicken nuggets.

HIGHLIGHTS

- ➊ Addition of carrot and radish powder meat products improves the functional value of meat product along with enhancement of cooking yield and texture of the meat product.
- ➋ Addition of more fiber results in improvement of nutritional and structural properties of chicken nuggets.

Keywords: Carrot powder, Radish powder and Chicken nuggets

Meat and meat products are naturally high in protein, fat, minerals, and vitamins, and are considered an important element of the diet. Meat has become a popular consumer item all across the world, with the industrialized western countries having the greatest consumption rates.

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Meat provides a major portion of the necessary dietary requirements for proteins, vitamins B, magnesium, iron, and zinc. Poultry meat is a good option when it comes to fulfill all these nutritional requirements with barely any social taboo. (Vetrivel and Chandrakumarmangalam, 2013) Poultry meat has very high production rate all over the world including India. Though poultry meat is very rich source of vitamins, minerals and proteins but it lacks in one of the essential nutrient component that is fibre. And consumers now a day's became very aware about the food they eat and they highly prefer a diet with low cholesterol and high fiber content. Over the last decade, snack food has become one of the fastest growing segments of the food sector, with tremendous growth (Thakur and Saxena 2000). Chicken nuggets are the products containing deboned chicken meat which is breaded or battered then deep fried or backend. Chicken nuggets are getting famous in Indian market specifically as a ready to eat meat product. Incorporation of dietary fiber in the food has many health advantages. Inclusion of fiber in the diet can minimize the risk of obesity, cardio vascular diseases and obesity. So making the meat products with incorporation of fiber based ingredients can be a good option for improving the nutritional and textural properties of meat. Incorporating the vegetables in the meat which are rich in fiber can counteract the fiber deficiency in meat along with reducing the cost of production of meat product. It has been proved that when vegetables were added in meat products the functional value of meat product was improved, the cooking yield, texture of the meat product was also enhanced. So vegetables like carrot and radish can be a good option to add in chicken nuggets to fulfill the fiber demand of the consumers.

Carrot (*Daucus carota*) is an essential root vegetable which is high in bioactive substances such as carotenoids and dietary fibre, as well as a variety of other functional components with health-promoting effects (Sharma *et al.* 2012). Carrot consumption is constantly growing as a result of its recognized as a valuable source of natural antioxidants with anticancer properties as well as a rich source of fiber. The anti-carcinogenic factor present in carrot (Beta carotene) helps to prevent heart attack, ulcers, gum diseases and stroke (Kumar *et al.* 2015). Consumption of carrots

also promotes wound healing and improves the digestive health. A medium carrot has 1.7 g of fibre in it, which is around 5–7.6% of a person's daily fibre requirements. Depending on their age and gender, they are a reliable source. Meanwhile, 3.58 g of fibre may be found in 1 cup of sliced carrots.

When it comes to adding a vegetable ingredient in the meat product radish also can be a good option. Radish the member of Brassicaceae family is a rich source of antioxidants like catechin, vanillic acid, pyrogallol and other phenolic compounds. Radish is also a good source of iron, calcium and vitamin C. Radishes are commonly eaten raw as a crisp vegetable, mostly in salads, although they also feature in many European recipes. Radish root has an anti-diabetic impact and looks to be highly helpful in diabetes patients. Its capacity to strengthen the antioxidant defense system and reduce oxidative stress and lipid peroxidation, improve hormonal-induced glucose hemostasis, accelerate glucose uptake and energy metabolism, and minimize glucose absorption in the gut might explain its anti-diabetic characteristics (Banihani, 2017). So adding the vegetables like carrot and radish will surely enhance the nutritional and structural properties of meat product like chicken nuggets with more fiber and less fat. It will also assist in reducing the formulation cost of meat products. Hence present study was carried out with an objective to study the effect of carrot and radish powder on proximate, sensory and physico-chemical characteristics of chicken nuggets

MATERIALS AND METHODS

Broiler bird procured from poultry farm of College of Veterinary and Animal Sciences, Parbhani were slaughtered and dressed in the experimental slaughter house of the COVAS, Parbhani as per standard procedures and guidelines for animal welfare and ethics. Dressed carcasses were packed in LDPE bags and stored overnight at $4\pm1^{\circ}\text{C}$ temperature. The dressed birds were manually deboned and meat free from visible fat and connective tissue, was packed in LDPE bags and frozen for 24 hrs. Carrot and radish powder were supplied by Earth Expo Company, Bhavnagar, Gujrat. Other material including spices, condiments and refined wheat flour used in the present study were procured from local market.



Preparation of chicken nuggets

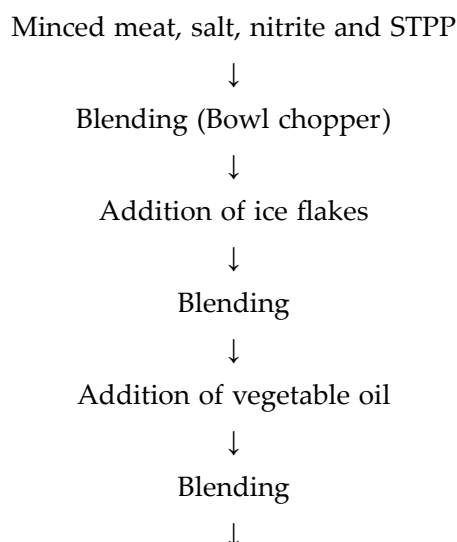
Chicken nuggets will be prepared from emulsion in the manner as described by Rindhe *et al.* (2018), with minor modifications.

Table 1: Basic formulation of chicken nuggets

Sl. No.	Particular	Quantity (% by weight)
1	Deboned meat	67.00
2	Oil	08.00
3	Salt	1.50
4	STPP	0.20
5	Water	8.00
6	Flour (Maida)	4.00
7	Spice mix	2.50
8	Condiments	4.00
9	Sugar	0.30
10	Eggs	4.50
Total		100

Chicken nuggets were prepared from the frozen deboned meat which was first chopped into pieces and minced in meat mincer after thawing at room temperature as shown in the flow diagram 1. Carrot and radish powder were added in chicken nuggets with proportion of 4, 8 and 12% and the nuggets were subjected to sensory and physico- chemical analysis and compared with control group. From the sensory proximate and physico- chemical analysis the optimum level of carrot and radish powder was selected to be added in chicken nuggets.

Flow diagram for the preparation of chicken nuggets



Addition of whole egg liquid/bread crump's and refined oil



Blending for 2 minutes



Addition of carrot powder/radish powder, condiments and spice mix



Chopping



Emulsion



Moulding



Cutting into nuggets



Packaging and storage (4±1°C)

ANALYSIS

Proximate Analysis

Proximate parameters viz., moisture, protein, fat and ash measurement were done according to the methods described by AOAC (1995). To determine the moisture percent, 10-g sample was dried at 100 ± 5 °C to constant weight. After analysis of total nitrogen using Kjeldahls method, a factor of 6.25 was used to derive total protein (%). Fat percent was estimated using Soxhlet apparatus. Total ash was determined by using muffle furnace (550 ± 5 °C for 6 h). The crucible with residue was oven dried (105 ± 5 °C) overnight and weighed. The crucible and its content were then transferred into a muffle furnace and ashing was done at 550 ± 5 °C for 4 h, cooled and reweighed. The weight of ash was then calculated as g/100 g of original sample.

Energy

The energy was calculated as per the method described by Rindhe *et al.* (2018). Total calories content of cooked products were calculated as per the methods used by Verma *et al.* (2016). For 100-g portion using at water values for fat (9 kcal/g), protein (4.02 kcal/g) and carbohydrate (4 kcal/g).

Physico-chemical attributes

pH

Using the Trout *et al.* (1992) method, the pH of chicken emulsion and nuggets was determined. After combining 10 gram of cooked chicken nuggets/emulsion with 50 ml of distilled water, the pH of the suspension was determined using a digital pH meter.

Cooking yield (%)

The weight of chicken nugget was taken before and after cooking and expressed in percentage.

Cooking yield =

$$\frac{\text{Weight of cooked nugget}}{\text{Weight of uncooked nugget}} \times 100$$

The moisture retention in chicken nuggets was calculated as per the equation used by Kumar *et al.* (2007).

$$\text{Moisture retention (\%)} = \frac{\text{Cooking yield (\%)} \times \text{Moisture in nuggets (\%)}}{100}$$

Fat retention

Retention of fat in chicken nuggets was calculated as per the equation used by Kumar and Sharma (2003) as follows:

Fat retention =

$$\frac{(\text{Cooked weight}) \times \text{Fat (\%)} \text{ in cooked nuggets}}{(\text{Uncooked weight} \times \text{Fat (\%)} \text{ in uncooked nuggets})} \times 100$$

Sensory evaluation

Using an 8-point descriptive scale (Keeton 1983), a panel of academic staff members and post graduate students from the College of Veterinary and Animal Sciences, Parbhani evaluated the quality of chicken nuggets on the basis of sensory criteria such as appearance, flavor, juiciness, texture, and overall acceptability.

RESULTS AND DISCUSSION

(A) Effect of carrot powder on quality of chicken nuggets

Table 1 Shows the results on the proximate composition, physico-chemical, and sensory aspects of chicken nuggets incorporated with carrot powder.

Table 1: Proximate composition, physio-chemical and sensory properties of chicken nuggets added with carrot powder (CP) (Mean±S.E.)*.

Parameters	Carrot powder (CP) levels			
	Control	CP-4	CP-8	CP-12
Proximate composition				
Moisture (%)	59.22 ± 0.20 ^a	61.53 ± 0.36 ^b	61.88 ± 0.35 ^{bc}	62.02 ± 0.13 ^c
Protein (%)	18.03 ± 0.15 ^d	17.50 ± 0.12 ^c	16.80 ± 0.27 ^b	15.72 ± 0.33 ^a
Fat (%)	10.43 ± 0.46 ^d	9.41 ± 0.12 ^c	9.19 ± 0.11 ^b	8.93 ± 0.09 ^a
Ash (%)	1.88 ± 0.08 ^a	2.34 ± 0.14 ^b	2.70 ± 0.18 ^c	3.03 ± 0.13 ^d
Moisture: Protein ratio	3.28 ± 0.06 ^a	3.52 ± 0.07 ^b	3.68 ± 0.03 ^c	3.95 ± 0.10 ^d
Energy (Kcal)	188.51 ± 0.19 ^d	185.18 ± 0.23 ^c	183.78 ± 0.53 ^b	181.91 ± 0.61 ^a
Physico-chemical attributes				
pH	6.15 ± 0.03	6.16 ± 0.04	6.17 ± 0.03	6.17 ± 0.03
Cooking Yield (%)	89.28 ± 0.30 ^a	91.35 ± 0.31 ^b	92.15 ± 0.34 ^c	92.38 ± 0.32 ^c
Moisture Retention (%)	34.26 ± 0.34 ^a	36.47 ± 0.84 ^b	38.63 ± 0.52 ^c	39.07 ± 0.54 ^c
Fat Retention (%)	89.63 ± 0.27 ^a	91.24 ± 0.51 ^b	93.44 ± 0.61 ^c	93.81 ± 0.48 ^c
Sensory evaluation*				
Appearance	7.28 ± 0.01 ^c	7.21 ± 0.02 ^b	7.20 ± 0.01 ^b	7.17 ± 0.02 ^a
Flavour	7.28 ± 0.01 ^c	7.19 ± 0.02 ^b	7.17 ± 0.02 ^b	7.06 ± 0.03 ^a
Texture	7.33 ± 0.01 ^c	7.18 ± 0.04 ^b	7.17 ± 0.02 ^b	7.01 ± 0.05 ^a
Juiciness	7.30 ± 0.02 ^c	7.21 ± 0.05 ^b	7.19 ± 0.04 ^b	7.06 ± 0.06 ^a
Overall Acceptability	7.21 ± 0.01 ^c	7.18 ± 0.01 ^b	7.17 ± 0.02 ^b	7.06 ± 0.04 ^a

n = 6, *n=21 *Mean ± SE. with different superscripts row wise (small alphabets) differ significantly (p<0.05) **CON** = Chicken nuggets without carrot powder (CP), **CP-4** = nuggets with 4.0 % CP, **CP-8** = nuggets with 8.0 % CP and **CP-12** = nuggets with 12.0 % CP.



Fig. 1: Chicken nuggets Prepared with Carrot powder.
(A) Control (without carrot powder) (B) 4% carrot powder
(C) 8% carrot powder (D) 12% carrot powder

Proximate analysis

Moisture

The table 1 shows that as the amount of carrot powder in chicken nuggets rose, the moisture % increased considerably ($p < 0.05$). Devatkal *et al.* (2004) made a similar discovery. They discovered that adding carrot paste to buffalo liver veggie bread resulted in a greater moisture percentage. According to Singh *et al.* (2015), increasing the amount of carrot powder in chicken flesh cutlets enhanced the moisture percentage of the product. As carrot powder is added to chicken nuggets, the moisture percentage increases significantly ($P < 0.05$) when compared to the control. In comparison to the control, the 12 percent carrot powder included chicken nugget had the highest moisture percentage.

Protein and Fat

The protein and fat content of chicken nuggets made with carrot powder decreased considerably ($P < 0.05$) as the amount of carrot powder used increased. The findings are consistent with Kumar *et al.* (2015), who

found that increasing the amount of carrot pomace dry powder lowered the protein and fat percentage of chicken cutlets.

Ash

Because of the carrot powder, the ash percentage also changed considerably ($P < 0.05$). As the amount of carrot powder was increased, the ash percentage rose. El Anany *et al.* (2020) for example, made a similar discovery. They discovered that chicken nuggets made with various quantities of frozen white cauliflower had greater ash content than control nuggets.

Moisture: protein ratio

With the addition of more carrot powder, the moisture: protein ratio exhibited a substantially ($P < 0.05$) increased trend.

Energy

With increasing the level of carrot powder, the energy exhibited a substantially ($P < 0.05$) decreasing trend. Similar findings were reported by El Anany *et al.* (2020). According to Keenan *et al.* (2014) when several types of meat products were manufactured by adding dietary fibre, the fat content and energy of the product were inversely connected.

Physico-chemical attributes

pH

With the addition of carrot powder, the pH rose somewhat. However, the rise in pH was not statistically significant ($p > 0.05$). Mendiratta *et al.* (2013) also discovered that the pH values of control and carrot, radish, and capsicum integrated mutton nuggets were not significantly different.

Cooking yield

When the amount of carrot powder was increased, the cooking yield improved considerably ($P < 0.05$). Ponsingh *et al.* (2017) discovered that buffalo meat sausage produced with 7% potato flour yielded a higher cooking yield. Zargar *et al.* (2017) found that as the amount of carrot in chicken sausage grew, the cooking output of the sausage reduced dramatically.

Moisture retention

In comparison to the control, the moisture retention of chicken nuggets prepared with carrot powder shows a significantly ($P<0.05$) increasing trend. Verma *et al.* (2016) discovered similar results. They discovered that when the amount of green cabbage in the chicken meat ball rose, the moisture retention properties of the chicken meat increased considerably ($P<0.05$). However, the difference between 8 percent and 12 percent carrot powder included chicken nuggets is not significant ($P>0.05$).

Fat retention

The fat retention percentage rose as the amount of carrot powder in chicken nuggets increased. The finding is in accordance with Serdaroglu *et al.* (2018). They discovered that adding dry pumpkin pulp and seed combination to the sample increased fat retention.

Sensory evaluation

As shown in the table, the sensory score for all aspects such as appearance, flavour, texture, and juiciness varied dramatically depending on the amount of carrot used. With increased carrot powder integration, all sensory metrics show a considerable decrease in trend. However, there is no discernible difference between chicken nuggets with 4 percent and 8 percent carrot powder. All of the sensory measures were lowest for chicken nuggets with 12% carrot powder.

(B) Effect of radish powder on quality of chicken nuggets

Table 2 Shows the results on the proximate composition, physico-chemical, and sensory aspects of chicken nuggets incorporated with radish powder.

Table 2: Proximate composition, physio-chemical and sensory properties of chicken nuggets added with radish powder (RP) (Mean $\pm$ S.E.)*

Parameters	Control	Radish powder (RP) levels		
		RP-4	RP-8	RP-12
Proximate composition				
Moisture (%)	60.12 ± 0.07 ^d	59.72 ± 0.06 ^c	58.40 ± 0.07 ^b	57.10 ± 0.04 ^a

Parameters	Control	Radish powder (RP) levels		
		RP-4	RP-8	RP-12
Protein (%)	18.10 $\pm$ 0.06 ^d	17.81 $\pm$ 0.04 ^c	16.01 $\pm$ 0.08 ^b	15.36 $\pm$ 0.05 ^a
Fat (%)	10.10 $\pm$ 0.07 ^d	9.24 $\pm$ 0.03 ^c	8.29 $\pm$ 0.02 ^b	8.03 $\pm$ 0.03 ^a
Ash (%)	1.93 $\pm$ 0.03 ^a	2.41 $\pm$ 0.05 ^b	2.52 $\pm$ 0.02 ^c	2.65 $\pm$ 0.61 ^d
Moisture: Protein ratio	3.32 $\pm$ 0.06 ^a	3.35 $\pm$ 0.07 ^a	3.65 $\pm$ 0.08 ^{bc}	3.72 $\pm$ 0.11 ^c
Energy (Kcal)	187.12 $\pm$ 0.18 ^d	184.02 $\pm$ 0.22 ^c	182.64 $\pm$ 0.52 ^b	180.15 $\pm$ 0.59 ^a
Physico-chemical attributes				
pH	6.12 $\pm$ 0.04	6.15 $\pm$ 0.04	6.16 $\pm$ 0.04	6.16 $\pm$ 0.04
Cooking Yield (%)	89.33 $\pm$ 0.28 ^a	91.03 $\pm$ 0.29 ^b	91.88 $\pm$ 0.38 ^c	92.17 $\pm$ 0.34 ^c
Moisture Retention (%)	34.14 $\pm$ 0.31 ^a	35.10 $\pm$ 0.64 ^b	37.48 $\pm$ 0.62 ^c	38.01 $\pm$ 0.65 ^c
Fat Retention (%)	89.54 $\pm$ 0.29 ^a	90.91 $\pm$ 0.42 ^b	92.94 $\pm$ 0.91 ^c	93.76 $\pm$ 0.87 ^c
Sensory evaluation[†]				
Appearance	7.16 $\pm$ 0.02 ^b	7.22 $\pm$ 0.02 ^c	7.26 $\pm$ 0.02 ^d	7.11 $\pm$ 0.01 ^a
Flavour	7.11 $\pm$ 0.02 ^b	7.16 $\pm$ 0.03 ^c	7.22 $\pm$ 0.01 ^d	7.06 $\pm$ 0.02 ^a
Texture	7.21 $\pm$ 0.02 ^c	7.16 $\pm$ 0.02 ^b	7.16 $\pm$ 0.03 ^b	7.06 $\pm$ 0.04 ^a
Juiciness	7.21 $\pm$ 0.04 ^c	7.16 $\pm$ 0.04 ^b	7.11 $\pm$ 0.06 ^b	7.01 $\pm$ 0.03 ^a
Overall Acceptability	7.21 $\pm$ 0.02 ^c	7.11 $\pm$ 0.05 ^b	7.16 $\pm$ 0.05 ^b	7.01 $\pm$ 0.04 ^a

$n = 6$, * $n=21$ *Mean $\pm$ SE. with different superscripts row wise (small alphabets) differ significantly ($p<0.05$) CON = Chicken nuggets without radish powder (RP), RP-4 = nuggets with 4.0 % RP, RP-8 = nuggets with 8.0 % RP and RP-12 = nuggets with 12.0 % RP.



Fig. 2: Chicken nuggets prepared with radish powder. (A) Control (without radish powder) (B) 4% radish powder (C) 8% radish powder (D) 12% radish powder



Proximate analysis

Moisture

Between the radish-infused chicken nuggets and the control group, there is a significant ($P<0.05$) difference in moisture. With the addition of more radish powder, the moisture percentage fell. The current findings are consistent with those of Ozaki *et al.* (2021).

Protein and fat

A significantly ($P<0.05$) declining trend was observed for the protein and fat percentage of chicken nuggets incorporated with radish powder as compared to control. Decrease in protein content of radish incorporated chicken nuggets may be due to less amount of protein present in radish. The findings are in relevance with Mendiratta *et al.* (2013).

Ash

A significant increase in ash percentage is observed with increase in amount of radish powder added in chicken nuggets.

Moisture: protein ratio

With the addition of radish powder, the moisture: protein ratio increased considerably ($P<0.05$).

Energy

The energy of chicken nuggets with radish powder differs significantly ($P<0.05$) from that of the control. As the amount of radish powder in the mixture increased, the energy level fell.

Physico-chemical attributes

pH

The pH of chicken nuggets with radish powder was not substantially different ($P>0.05$). The pH increased slightly when the amount of radish powder was increased. The findings are consistent with those of Mendiratta *et al.* (2013). They found that when mutton nuggets with carrot and radish were compared to control, there was no significant variation in pH readings.

Cooking yield

With a larger amount of radish powder, the cooking yield increased considerably ($P<0.05$). Mendiratta *et al.* (2013) observed similar findings. They discovered that radish-infused mutton nuggets had a greater cooking output than the control group. This might be related to radish fiber's ability to retain moisture during cooking.

Moisture retention and fat retention

Increased radish powder concentration results in a significant ($P<0.05$) increase in moisture and fat retention. According to Verma *et al.* (2016), adding green cabbage to chicken meat balls enhanced the moisture retention of the meat balls. When beef meat balls were mixed with 20% potato puree, Ergezer *et al.* (2014) found that fat retention increased.

Sensory evaluation

The table shows that radish-incorporated chicken nuggets differed significantly ($P<0.05$) in all sensory characteristics such as appearance, flavour, texture, juiciness, and overall acceptability. For 4 percent and 8% radish integrated chicken nuggets, there is a substantial ($P<0.05$) increase in appearance and flavour score when compared to control, however for 12 percent radish incorporated chicken nuggets, the lowest score for appearance and taste is seen. When compared to control, greater levels of radish powder result in a considerably ($P<0.05$) worse texture score, however the difference was non-significant for 4 and 8 percent radish included chicken nuggets.

CONCLUSION

The effect of different level of carrot and radish powder on quality attributes of chicken nuggets was studied. During the experiment it was observed that addition of 8% carrot powder and 8% radish powder separately were found most appropriate and comparable to control for development of chicken nuggets.

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