CHICKEN MEAT BALLS WITH BEETROOT *(BETA VULGARIS)* POMACE POWDER AS FUNCTIONAL INGREDIENT

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ABSTRACT

Emulsion based chicken meat balls were prepared with the addition of beetroot pomace powder (BPP) at levels of 1%, 2% and 3%, over and above the amount of meat along with a control without BPP, and the physico-chemical and sensory properties were assessed. Addition of BPP significantly increased the emulsion pH and non significantly increased product pH and emulsion stability. Product yield of 3% BPP incorporated chicken meat balls were significantly higher as compared to other treatments and control. Sensory evaluation scores were significantly higher in 1% BPP incorporated chicken meat balls followed by 2% and 3% BPP incorporated chicken meat balls. From this result, it is concluded that emulsion based functional chicken meat balls could be fortified with dietary fibre content by the inclusion of beetroot pomace powder up to a level of 3% without affecting the physico-chemical and sensory qualities.

Key words: Chicken meat balls, Beetroot pomace powder, Dietary fibre, Physico-chemical properties, Sensory properties

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INTRODUCTION

It is a well known fact that vegetables are rich sources of dietary fibre. In the recent decades, the dietary habits of the people had changed extremely with more inclusion of easy to cook fast foods and ready to eat foods. The non-vegetarian consumers prefer the delicious variety meat foods that could be easily prepared and are less time consuming. These practices had led to a diet deficient in many nutritional factors, especially the dietary fibre, which is highly recommended in the regular diet. To combat this deficiency, it is essential to develop healthy eat foods with inclusion of vegetable components. Various meat foods enriched with natural dietary fibres had been developed previously (Santhi and Kalaikannan, 2014; Kasthuri *et al.,* 2016;

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Uikey and Nayak, 2019; Zinina *et al.,* 2019; Santhi *et al.,* 2020).

Beetroot (*Beta vulgaris*) pomace from the juice industry which is usually disposed as feed and manure (Čanadanović-Brunet *et al*., 2011) is one of the potential dietary fibre source (Sahni and Shere, 2017) with 39.53 (g/100 g) insoluble dietary fibre and 21.33 (g/100 g) soluble dietary fibre (Shyamala and Jamuna, 2010). Many food products had been developed with inclusion of beetroot pomace (Sahni and Shere, 2016; Parveen *et al*., 2017; Kohajdova *et al*., 2018; Alshehry, 2021; Marrone *et al*., 2021).

Convenient snack foods prepared with chicken meat have become a part of daily food in the recent past. Since meat is naturally devoid of fibre, it is vital to develop healthy meat foods rich in dietary fibre. Hence this study was conducted to fortify chicken meat balls with dried beetroot pomace dietary fibre source and to assess the physico-chemical and sensory properties.

MATERIALS AND METHODS

Source of raw materials

Beetroot pomace powder (BPP): Fresh beetroot (*Beta vulgaris*) was purchased from market and processed in the laboratory. The beetroot was washed thoroughly to remove the adhering soil particles, peeled off and crushed in a juice extractor to obtain the juice and the pomace. The pomace was then dried in hot air oven by placing on a drying tray at 60^{o}C for 16 hours, ground to flour and stored at room temperature (37±1°C) for use in the experiment.

Broiler meat: Deboned broiler chicken meat was minced through an 8-mm plate using a meat mincer, packaged in low-density polyethylene (LDPE) and stored in the laboratory freezer at -18±2^{o}C for subsequent use in the experiments.

Other ingredients: Commercially available food grade ingredients available in the local market were used for the preparation of spice mix, green condiments, and the meat ball formulation in the present the study.

Preparation of chicken meat balls

The emulsion was prepared in a bowl chopper by adding minced meat and the other ingredients of the formulation (Table 1). During chopping, the temperature of the emulsion was maintained at 10-12˚C by the addition of slush ice. BPP was added at levels of 0% (C), 1% (BPP1), 2% (BPP2) and 3% (BPP3) over and above the control formulation. Meat balls of around 10 g weight each were formed manually and placed on stainless steel trays. Water was preheated to 50^{o}C in a cooking vessel and the formed meat balls were cooked in the water to an internal core temperature of 82˚C. After cooking, the meat balls were allowed to cool at room temperature, weighed and were used for various physico-chemical and sensory characteristics.

Analytical procedures

Physico-chemical evaluation

***pH*:** The pH of emulsion and cooked product was determined by adopting the method of AOAC (1995).

***Emulsion stability (ES)*:** The ES was calculated by the formula

$$ES\ (\%) = \frac{Weight\ of\ emulsion\ after\ heating}{Raw\ emulsion\ weight}\ X\ 100$$

Product yield: Weights of meat balls before and after cooking were recorded. The product yield was calculated as below

$$Product\ yield(\%) = \frac{Weight\ of\ cooked\ chicken\ meat\ balls}{Raw\ meat\ balls\ weight}\ X\ 100$$

Sensory evaluation

Trained sensory panel consisting of students and teaching faculty of the college evaluated the products. Samples were evaluated for appearance and colour, flavour, juiciness, texture, tenderness and overall acceptability using an 8- point hedonic scale.

Statistical analysis

Data generated were subjected to statistical analysis (Snedecor and Cochran, 1994) for analysis of variance, critical difference and Duncan's multiple range test was done for comparing the means to find the effect of treatment using the statistical software SPSS for windows.

RESULTS AND DISCUSSION

Physico – chemical characteristics of control and BPP incorporated chicken meat balls are presented in table 2. Addition of BPP increased the emulsion pH which might be due to a slight high pH of BPP. Product pH (PpH) was not affected by the addition of BPP. Similarly in earlier studies, addition of beetroot powder to chicken sausage (Swastike *et al*., 2020) and Turkish fermented beef sausage (Sucu and Turp, 2018) caused no significant change in the PpH. Product yield of 3% BPP incorporated chicken meat balls were significantly higher as compared to other treatments and control. Islam and Khan (2016) observed an increase in the cooking yield of chicken patties with addition of beetroot powder with improved fat retention. This difference in the results might be due to the variation the product formulation and cooking methods.

Sensory evaluation results are presented in Table 3. Appearance score greatly decreased with increase in the levels of BPP. This might be due dark colour in BPP incorporated chicken meat balls. Though 3% level of inclusion significantly reduced the overall acceptability, it was near to "very acceptable" score. El-Gharably and Ashoush (2011) observed that the scores of colour, flavour and overall palatability significantly decreased at 5% inclusion level of red beet powder in beef sausages and hence suggested a 3% inclusion level without affecting sensory quality. Cava *et al*. (2012) also observed that the colour of chopped cooked chicken products and the batters were significantly affected by addition of beet root fiber. They also observed that the hardness increased with addition of beet root fiber which might be the reason for decrease in texture score of meat balls in the the present study. Addition of beetroot powder up to 3% level to chicken sausages did not affect its sensory qualities (Swastike *et al*., 2020). Though the advantages of utilizing beet root in functional foods and nutraceutical products had been portrayed (Ninfali and Angelino, 2013) it has not been exploited completely in the area of food processing.

Table 1

Formulation of chicken meat balls with inclusion of beetroot pomace powder (BPP)

Ingredients (g)	Treatments with Beetroot Pomace Powder			
	C	1% (BPP1)	2% (BPP2)	3% (BPP3)
BPP%	**0**	**1**	**2**	**3**
Lean meat	1000	1000	1000	1000
Vegetable oil	50	50	50	50
Refined wheat flour	40	40	40	40
Beetroot pomace powder	-	10	20	30
Salt	20	20.20	20.40	21.60
Ginger	25	25.25	25.50	25.75
Garlic	25	25.25	25.50	25.75
Onion	25	25.25	25.50	25.75
Spice mix	20	20.20	20.40	21.60
Added water	100	105	110	115

Table 2

Effect of addition of beetroot pomace powder on the physico-chemical qualities of chicken meat balls

Quality attributes	Treatments				Significance
	C	BPP1	BPP2	CPP3	
Emulsion pH	6.15±0.01^{b}	6.18±0.01^{a}	6.18±0.00^{a}	6.19±0.00^{a}	*
Product pH	6.34±0.00	6.34±0.01	6.36±0.02	6.34±0.02	NS
Emulsion stability (%)	95.20±0.25	95.59±0.39	95.74±0.47	95.44±0.16	NS
Product Yield (%)	91.55±0.12^{a}	90.64±0.20^{b}	90.12±0.14^{b}	91.59±0.24^{a}	**

C - Control, BPP1 - 1% BPP, BPP2 - 2% BPP, BPP3 - 3% BPP

Means in a row with different superscripts are significantly different

** - Highly significant (P≤0.01)

*- Significant (P≤0.05)

^{NS} - Not Significant

Table 3

Effect of addition of beetroot pomace powder on the sensory quality of chicken meat balls

Quality attributes	Treatments				Significance
	C	BPP1	BPP2	BPP3	
Appearance and colour score	7.58±0.15^{a}	6.67±0.14^{b}	6.33±0.14^{b}	5.50±0.15^{c}	**
Flavour score	7.42±0.15^{a}	7.00±0.12^{b}	6.50±0.15^{c}	6.42±0.15^{c}	**
Juiciness score	7.42±0.15^{a}	7.08±0.08^{ab}	6.75±0.13^{b}	6.33±0.14^{c}	**
Texture score	7.42±0.15^{a}	7.25±0.13^{a}	6.83±0.11^{b}	6.75±0.13^{b}	**
Tenderness score	7.50±0.15^{a}	7.42±0.15^{a}	6.75±0.13^{b}	6.92±0.08^{b}	**
Overall acceptability score	7.42±0.15^{a}	7.33±0.14^{ab}	7.00±0.12^{bc}	6.75±0.13^{c}	**

C - Control, BPP1 - 1% BPP, BPP2 - 2% BPP, BPP3 - 3% BPP
Means in a row with different superscripts are significantly different
** - Highly significant (P≤0.01)

CONCLUSION

The nutritional benefits of beetroot were proven by many earlier researchers and various food and meat products with incorporation of beetroot had been developed. Extensive research needs to be carried out to utilize the benefits of beetroot in the food products, especially in meat foods. From this study, it is concluded that emulsion based functional chicken meat balls could be fortified with dietary fibre content by the addition of beetroot pomace powder up to a level of 3% without affecting the physico-chemical and sensory qualities.

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