

ANTIOXIDANT POTENTIAL OF INDIAN GOOSEBERRY (*Emblica officinalis*) AQUEOUS EXTRACT IN CHICKEN MEAT BALLS

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ABSTRACT

*This study was conducted to evaluate the antioxidant potential of Indian gooseberry (*Emblica officinalis*) aqueous extract in chicken meat balls and the assessment of the physico-chemical and sensory properties of the meat balls. Chicken meat balls were prepared with the inclusion of Indian gooseberry aqueous extract (GBAE) at 0, 9%, 12% and 15% levels. The emulsion pH, product pH, emulsion stability and product yield were determined. DPPH scavenging activity (%) was studied to establish the antioxidant potential of the GBAE in the product. Sensory properties were evaluated using 8 point hedonic scale. Emulsion pH and product pH decreased significantly ($P<0.05$) with the addition of GBAE. Product yield decreased significantly ($P<0.05$) with the addition of GBAE at 12% and 15% levels. DPPH scavenging activity significantly ($P<0.01$) increased with increase in the GBAE inclusion level, where 15% treatment had the highest antioxidant potential followed by 12% and 9% treatments. The sensory scores of control and 9% treatment were comparable and the scores were significantly ($P<0.05$) lower for 12% and 15% treatments. From this study, it is observed that GBAE could be added as a potential antioxidant in the chicken meat balls, up to a level of 9% without affecting the physico-chemical and sensory qualities of the product.*

Keywords: Chicken meat balls, *Emblica officinalis*, Gooseberry aqueous extract, Antioxidant activity

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INTRODUCTION

In the Indian agricultural industry, poultry production and processing is one of the fastest growing sectors. Globally, India is one of the leading producers of poultry meat. The major criteria in extending the shelf-life of meat products is to minimize/prevent the microbial growth and chemical changes that occur during the product during storage. The critical chemical change that causes quality deterioration is lipid oxidation (Domínguez *et al.*, 2019) which may lead to adverse effects on the organoleptic attributes and the nutritional quality of the products. Hence inclusion of natural antioxidants as preservative is imperative to improve the storage quality of the meat products.

Emblica officinalis, commonly known as Indian gooseberry is a tropical medicinal plant with good therapeutic properties, and is widely distributed in India. Various parts of the gooseberry plant are used to treat a range of diseases, but the most important is the fruit. Gooseberry fruit is rich in antioxidants like vitamin C, emblicanin A and B, punigluconin, pedunculagin, superoxide dismutase, catalase, glutathione peroxidase (Bhattacharya *et al.*, 2000), tannin, trigalloyl, polyphenol, flavonoids, ellagic acid and phyllembic acid (Anilakumar *et al.*, 2004). In addition, gooseberry also possess antifungal, antibacterial and antiviral activities (Rani and Khullar, 2004).

Different meat products had been developed incorporating various forms of gooseberry in (Argade *et al.*, 2018; Kumaresan *et al.*, 2019; Kumaresan *et al.*, 2020; and Goswami Mayank *et al.*, 2020). Inclusion of gooseberry in meat products will attract

consumer acceptance. Hence, the present study was carried out with the objective of assessing the antioxidant potential of the Indian gooseberry aqueous extract (GBAE) as a natural preservative in chicken meat balls.

MATERIALS AND METHODS

Raw materials

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

Indian gooseberry aqueous extract: Fresh Indian gooseberry was procured from the market and washed thoroughly. Then they were deseeded, sliced and blended in mixer-grinder for about 1 to 2 min. The resultant homogenate was squeezed through 4 layers of muslin cloth for preparation of the filtrate which was used as the aqueous extract.

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

Preparation of chicken meat balls

The chicken meat balls were prepared with the formulation given in Table 1. The emulsion was prepared by adding tempered minced meat and the other ingredients in a sequential order at a specified time interval, as shown in the flow chart. The frozen minced meat was thawed at 4°C by keeping in refrigerator overnight. In the treatment, GBAE at 9%, 12% and 15%, were added, over and above quantity of meat. A control

was maintained along with the treatments. During the preparation of emulsion, GBAE was added after the addition of vegetable oil. The ingredients were chopped to make a batter in bowl chopper.

Addition of minced meat to bowl chopper

(chopping for 1 min)



Addition of salt

(chopping for 1 min)



Addition of vegetable oil

(chopping for 1 min)



Addition of Indian gooseberry aqueous extract

(chopping for 1 min)



Addition of green condiments (garlic, ginger and onion paste)

(chopping for 1 min)



Addition of spice mix

(chopping for 1 min)



Emulsion

Meat balls of 10 g weight each were formed manually from the prepared emulsion and added in cooking vessel with preheated water at 50°C. Then the temperature was increased and meat balls were cooked till an internal core temperature of 82°C. After cooking, the meat balls were allowed to cool to room temperature. The product was then packaged in polyethylene bags aerobically for further analysis of quality characteristics. A total of six trials were conducted.

Analysis of the product

The physico-chemical quality characteristics such as emulsion pH, emulsion stability, product pH, product yield and DPPH scavenging activity, and the sensory quality characteristics such as appearance and colour, flavour, texture, juiciness, mouth coating and overall acceptability were analysed.

Physico-chemical properties:

Emulsion weight before cooking and product weight after cooking were recorded. The product yield was calculated by the formula “weight of meat balls after cooking/ raw emulsion weight × 100”. The pH of the chicken meat ball was recorded by immersing combined glass electrode and temperature probe of the digital pH meter (Model 361, Systronics, India). Emulsion stability was calculated by the formula “(Weight after heating)/(Raw emulsion weight) × 100”.

DPPH scavenging activity: DPPH (2, 2' diphenylpicrylhydrazyl) was determined following the procedure of Wu *et al.* (2003) with slight modifications. 1 g of GBAE added chicken meat ball was homogenized with 10 ml of ethanol. 1 ml of aliquot was taken, mixed with 5 ml of 0.1 mM DPPH solution, dissolved in 95% ethanol, incubated in darkness for 30 min and the absorbance at 517 nm was measured. DPPH scavenging activity was calculated by using the following formula

DPPH scavenging activity was calculated by using the following formula

$$\text{DPPH scavenging activity (\%)} = \frac{A_c - A_s}{A_c} \times 100$$

where,

Ac is the absorbance of the control (DPPH solution without sample)

As is the absorbance of the sample

Sensory evaluation: Semi trained sensory panel consisting of students and teaching faculty of the college evaluated the products. Samples were evaluated for appearance and colour, flavour, texture, juiciness, mouth coating and overall palatability using an 8-point hedonic scale (Keeton, 1983).

Statistical analysis

The data generated in the present study were subjected to statistical analysis (Snedecor and Cochran, 1995) for analysis of variance, critical difference and Duncan's multiple range tests for comparing the means to find the effect of treatment, storage period and their interactions. Then the data were tabulated and significance of difference were marked.

RESULTS AND DISCUSSION

Emulsion pH, product pH and emulsion stability of the chicken meat balls were significantly ($P < 0.01$) lowered due to the addition of GBAE at all levels. Product yield was not affected by 9% incorporation of GBAE but significantly ($P < 0.01$) lowered in 12% and 15% treatments. Amla fruit juice powder added to spent meat nuggets improved the cooking yield and emulsion stability (Mahajan *et al.*, 2017). In this study, there was a highly significant increase in the antioxidant activity of the GBAE added treatments corresponding to the level of inclusion as indicated by the DPPH scavenging activity where 15 % treatment had highest value (Fig

1). In analyzing the antioxidant efficacy of gooseberry, the free radical scavenging activity of gooseberry fruit extract was reported as 80.3 % by Prakash *et al.* (2012) and 89 % by Naveen *et al.* (2011). The DPPH radical scavenging activity of amla (gooseberry) fruit was 21.18 $\mu\text{mol TE/g}$ and its total phenolic content was 1164.83 mg GAE /100 g and it was observed that incorporation of 10 % amla fruit extract in goat meat patties significantly increased its total phenolic content and decreased the pH (Bariya *et al.*, 2018). Partial replacement of acetic acid with up to 3 % gooseberry powder in spent hen meat pickle caused significant reduction in the pH (Kumaresan *et al.*, 2019) and the pH did not change significantly during storage at room temperature up to 60 days (Kumaresan *et al.*, 2020). The decrease in pH and increase in the DPPH scavenging activity of the products with GBAE may be attributed to the presence of biologically effective chemical constituents such as tannins, alkaloids, polyphenols, gallic acid, ellagic acid, emblicanin A & B, phyllembein, quercetin and ascorbic acid contributing to the antioxidant potential of the gooseberry (Barthakur and Arnold, 1991).

In agreement with our results, Bariya *et al.* (2016) observed that goat meat patties incorporated with 10% GBAE had lower pH, lower free fatty acid content, lower TBA value and higher total phenolic content as compared to the control and seed coat extract incorporated patties. Najeeb *et al.* (2015) reported that addition of 1% gooseberry powder in restructured chicken block lowered the pH significantly compared to control whereas cooking yield was not affected. Similar to our observations, in

Table 1 - Chicken meat ball formulations with gooseberry aqueous extract

Ingredients (g)	C	GBAE9	GBAE12	GBAE15
Lean meat	1000	1000	1000	1000
Salt	20	20	20	20
Vegetable oil	50	50	50	50
Ginger	20	20	20	20
Garlic	20	20	20	20
Onion	20	20	20	20
Spice mix	20	20	20	20
Gooseberry extract	-	90	120	150

C	-	Control
GBAE9	-	Gooseberry aqueous extract 9%
GBAE12	-	Gooseberry aqueous extract 12%
GBAE15	-	Gooseberry aqueous extract 15%

Table 2 - Effect of inclusion of gooseberry aqueous extract on the physico-chemical qualities of chicken meat balls

Quality characteristics	Treatments				
	C	GBAE9	GBAE12	GBAE15	Significance
Emulsion pH	6.06 ^a ±0.21	5.52 ^b ±0.15	5.47 ^{bc} ±0.05	5.30 ^c ±0.01	**
Product pH	6.20 ^a ±0.11	5.67 ^b ±0.01	5.51 ^{bc} ±0.01	5.42 ^c ±0.02	**
Emulsion stability (%)	96.58 ^a ±0.35	94.38 ^b ±0.23	92.08 ^c ±0.12	90.49 ^d ±0.21	**
Product Yield (%)	89.89 ^a ±0.11	87.86 ^a ±0.46	85.14 ^b ±0.43	84.11 ^b ±1.52	**
DPPH Scavenging Activity (%)	12.17 ^d ±1.07	45.07 ^c ±2.47	60.08 ^b ±0.06	74.73 ^a ±2.15	**

Means within a row with different superscripts are significantly different

**Highly significant (P≤0.01)

C	-	Control
GBAE9	-	Gooseberry aqueous extract 9%
GBAE12	-	Gooseberry aqueous extract 12%
GBAE15	-	Gooseberry aqueous extract 15%

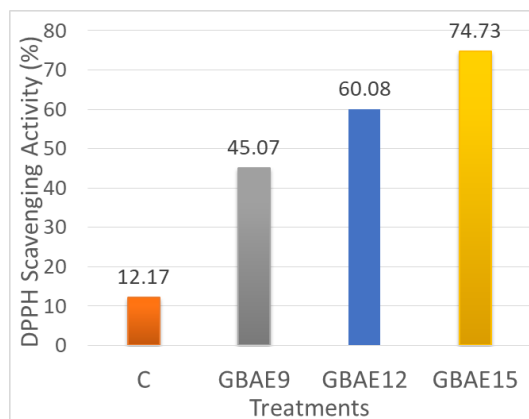
Table 3 - Effect of inclusion of gooseberry aqueous extract on the sensory qualities of chicken meat balls

Quality characteristics	Treatments				Significance
	C	GBAE9	GBAE12	GBAE15	
Appearance and colour score	6.92 ^a ±0.05	6.61 ^a ±0.10	5.94 ^b ±0.17	5.56 ^c ±0.11	**
Flavour score	6.73 ^a ±0.10	6.61 ^a ±0.10	5.97 ^b ±0.15	5.67 ^b ±0.13	**
Texture score	6.97 ^a ±0.06	6.58 ^b ±0.09	5.89 ^c ±0.17	5.50 ^d ±0.13	**
Juiciness score	6.81 ^a ±0.06	6.56 ^a ±0.09	5.94 ^b ±0.16	5.47 ^c ±0.15	**
Mouth coating score	6.94 ^a ±0.06	6.67 ^a ±0.10	5.86 ^b ±0.18	5.44 ^c ±0.19	**
Overall acceptability score	6.86 ^a ±0.05	6.69 ^a ±0.08	5.81 ^b ±0.15	5.31 ^c ±0.12	**

Means within a row with different superscripts are significantly different

**Highly significant (P≤0.01)

C	-	Control
GBAE9	-	Gooseberry aqueous extract 9%
GBAE12	-	Gooseberry aqueous extract 12%
GBAE15	-	Gooseberry aqueous extract 15%

**Figure 1 - Effect of inclusion of gooseberry aqueous extract on the physico-chemical qualities of chicken meat balls**

C	-	Control
GBAE9	-	Gooseberry aqueous extract 9%
GBAE12	-	Gooseberry aqueous extract 12%
GBAE15	-	Gooseberry aqueous extract 15%

evaluating the efficiency of gooseberry extract as a natural preservative in raw ground pork, Nanasombat *et al.* (2012) reported an increase in DPPH scavenging activity (EC₅₀ of 501.71 g extract/mg DPPH) and strongest reducing capacity (4.86 mmol/L) with the increase in concentration of the gooseberry extract which was related to its phenolic content (4,220 g GAE/mg dry extract). Gooseberry extract was added in raw meat batter and found to have good antimicrobial and antioxidative effect during 12 days refrigerated (4±1°C) storage without compromising other properties (Kumar and Langoo, 2016). Gooseberry powder was used as antioxidant in the refrigerated storage (4±1°C) of restructured buffalo meat steaks which extended the shelf-life of the product up to 20 days in aerobic packaging (Giriprasad *et al.*, 2015). Verma and Rajkumar (2021) observed that *amla* fruit extract could be used in the goat meat nuggets as an antioxidant to improve their shelf life under refrigerated conditions. Jat *et al.* (2021) replaced Indian gooseberry extract and powder to preserve chicken gizzard pickle at ambient temperature.

Only a few investigations are available till now with the addition of gooseberry preparations in meat products. However, considerable studies on other products with gooseberry had been carried out. Certain fruit juices and beverages prepared with the addition of gooseberry extract for vitamin C enrichment had pH in the range between 3 and 4 (Mishra *et al.* 2012). Hence in the present study, the decrease in pH of the GBAE added balls can be attributed to the low pH of the extract which in turn is due to the presence of high amount of phenolic content

in gooseberry. Since the emulsion stability depends on the pH of the emulsion and the product, a significant decrease in the emulsion pH had led to the lowering of emulsion stability and the product yield when GBAE was added at 12 and 15% levels.

The sensory characteristics of chicken meat balls incorporated with 9% GBAE were not significantly affected over control. But at 12% and 15% level there was a significant ($P<0.01$) reduction in all the sensory scores. The sensory panelists had expressed their remarks that they liked the sour taste imparted by the addition of 9% GBAE but it was very perceptible at 12% and 15% levels with a tangy flavour and hence was not very acceptable. In agreement with our findings, Bariya *et al.* (2016) developed sensorially acceptable chevon meat patties with addition of gooseberry extract at 10 % level. Incorporation of Indian gooseberry extract in chicken nuggets up to 1.5 % level did not cause organoleptic changes (Singh *et al.*, 2022). Similarly, Nanasombat *et al.* (2012) reported that the taste panelists could not discriminate between the control and ground pork treated with 2 % gooseberry extract. Keshatti (2003) reported that the ready to serve beverages with 2 % gooseberry was rated superior for overall acceptability. Thus, it is evident from the past and the present findings that the flavour and taste of GBAE should not cause product unacceptability upto certain level of inclusion.

CONCLUSION

The results of this study had shown that incorporation of Indian gooseberry aqueous extract in the chicken meat balls

significantly increased the antioxidant activity as indicated by the DPPH scavenging activity. Based on the physico-chemical and sensory evaluations, it could be concluded that Indian gooseberry aqueous extract could be added as a potential antioxidant in the chicken meat balls, up to a level of 9% without affecting the product quality.

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