The Pharma Innovation Journal 2022; SP-11(6): 2991-2993

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(6): 2991-2993

www.thepharmajournal.com
Received: 25-04-2022
Accepted: 30-05-2022

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Effect of green coffee extract on microbial characteristics of chevon nuggets at frozen storage

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Abstract
The study was conducted to evaluate the suitability of using of green coffee extract (GCE) and its effect on the microbiological quality of chevon nuggets during frozen storage. The chevon nugget treated with (GCE) had significantly ($P<0.05$) lower total plate count, psychrophilic count and yeast & mould count compared to control during storage at -18±2 ºC. Green coffee extract incorporation can be a very good approach to enhance nutritional profile of the meat products without affecting acceptability.

Keywords: Antioxidant, chevon nuggets, green coffee, microbiological

1. Introduction
Products from Chevon and Chevon are regarded as having great sensory quality (Kadim and Mahgoub, 2012). Chevon is virtually widely accepted, and there are no cultural, traditional, or social taboos that restrict its acceptance (Xazela *et al*., 2011) [11]. Meat products' high rate of perishability has been viewed as a highly severe issue, especially in tropical nations like India where there are few domestic refrigeration facilities (Kumar *et al.,* 2015). One of the main reasons why the quality of meat and meat products declines is lipid oxidation. Consumers of today seek foods with a high nutritional content, devoid of chemical preservatives, and free from microorganism danger. As a result, there is a widespread tendency toward using natural oxidants instead of synthetic antioxidants when processing food. A possible response to the current customer desire for low-fat and high-fiber meat products is the inclusion of fruits and vegetables as non-meat ingredients in processed meat products because of their inherent antioxidant activity, fibre content, and vitamin content (Yue, 2001) [10].
The amount of lipid oxidation products in food must be kept to a minimum in order to protect against any potential harmful effects on humans from oxidised lipids. When employed in various food applications, natural antioxidants derived from herbs and spices show varying degrees of efficiency (Bowser *et al.,* 2014) [3]. Different food and feed formulations use phytochemicals, in particular from artichoke, grape seed, betel, sage, green tea, pine wood, pomegranate, nettle, broccoli, mint, ginger, clove, cinnamon, and thyme. Vegetables, fruits, berries, herbs, and tea leaves contain flavonoids, the most effective phenolic plant antioxidants (Skrede and Wrolstad, 2002) [7]. India, the fifth-largest coffee grower in the world, has a considerable supply of green coffee ready for value addition. Benefits from ingesting green coffee infusions have long been acknowledged to be mostly attributable to the presence of phenolic chemicals, particularly chlorogenic acids, which have some antioxidant activity (Bicchi *et al*., 1995; Naidu *et al*., 2008; Suzuki *et al*., 2002) [2, 6, 9]. Green coffee beans, along with several fruits and vegetables, are the largest dietary sources of chlorogenic acid, which is one of the most common polyphenols. Chlorogenic acid is the ester of caffeic acid with quinic acid (Clifford, 1999) [4].

2. Materials and Methods
2.1 Meat and other ingredients
Goat flesh that had been deboned was purchased from a local market, wrapped in low density polyethylene bags, and refrigerated at 4 °C for later use. Frozen meat was thawed at 4±1 ºC for 24 hrs before use and cut into small pieces before grinding. Green coffee, refined salt, refined wheat flour, flaxseed powder, skim milk powder (Anikspray, Nutrica), and spice mix materials were purchased from the Jaipur local market. For the manufacture of the chevon nuggets, fine pastes of onion, garlic, and ginger in the proportion 3:1:1 were employed. Chemicals and media needed for product analysis were purchased from reputable companies including Sigma,

Mark, SRL, and Hi-media, among others.

2.2 Preparation of Chevon Nuggets

Overnight, frozen chevon was slightly thawed, then double minced with a meat mincer. A bowl chopper was used to prepare the meat emulsion (Hakimi, India). Salt, sodium tripolyphosphate, sodium nitrite, and minced chevon that had been pre-weighed were also added and chopped for two to three minutes. After the addition of ice flakes, it was chopped once again for two minutes. While cutting, animal fat was gradually mixed until the batter had all of it. Other components such as sugar, GCE, skim milk powder, flaxseed powder, and condiment paste were also incorporated. Until the required consistency of the emulsion and uniform distribution of all the ingredients were achieved, chopping was maintained. The emulsion was measured out and poured into a stainless steel mould. Mold was steam-cooked for 34 minutes with a lid on top and a thread tie.

Core temperature of cooked blocks was recorded by using probe thermometer that should reach to 75 ºC. Chevon meat block obtained was sliced and cut into pieces to get nuggets and stored at -18±2 ºC. At 15 days intervals sample were removed for analysis of microbiological quality. The analysis was continued for 15, 30, 45 and 60 day in frozen storage.

2.3 Analytical Procedure

2.3.1 Extract preparation

The dried grape seed was sieved after being ground in a grinder (Uno (mx-140), Groupe SEB India pvt. Ltd.) and air-dried for two hours at 50 °C in a hot air oven. Extracts from dried powdered seeds were made using an ether extraction assembly and 70% ethanol. The extracts had a dark brown colour. The extract was collected and concentrated till semi-solid consistency was achieved in a rotary vacuum evaporator (Labconco corporation, USA). To create solid mass, the semisolid mass was air dried. The same extraction solvent was used to reconstitute powdered components to create 5 percent stock solutions (0.5g of dry extract/10ml), which were then refrigerated at 4 °C for later use.

2.3.2 Microbiological examinations

According to the APHA (1984) [1] recommended procedures, the samples' total plate count, psychrophilic count, coliform count and yeast and mold count were all calculated.

2.4 Statistical Analysis

Data hence obtained through the experiments were analyzed as per Snedecor and Cochran (1994) [8] using Statistical Software Packages (SPSS 16.0).

3. Results and Discussion

3.1 Microbiological properties

Addition of GCE significantly ($P<0.05$) influenced the total plate count (TPC) of chevon nuggets during storage. At the end of storage period mean of the treatment T (2.56±0.01 log cfu/g) have significantly lower TPC than the control (2.66±0.01 log cfu/g) (Table 1). Throughout the storage period, TPC of T was lower than control. After the 60 days of storage, the TPC of T was significantly lower than the control. During the storage period there was a consistent increase in TPC of treatment and control.Similar findings were observed by Das *et al*. (2008) and Nath *et al*. (2016) who also found a similar increase in TPC during storage in goat meat nuggets and chicken nuggets respectively.

The psychrophilic count were not detected on zero day in both treatment and control but they appeared 15th day and to be significantly increase throuhout the storage period. At the end of storage period mean of treatment T (1.75±0.01 log cfu/g) have significantly lower psychrophilic count than the control (1.84±0.01 log cfu/g) (Table 1). After the 60 days of storage, the psychrophilic count of T was significantly lower than the control.

Yeast and molds were not detected till 30 day during frozen storage period in both control and antioxidant extract treated chevon nuggets, but they appeared on the 45th day of storage in both control and antioxidant treated product. At the end of storage period treatment T (0.65±0.02 log cfu/g) have lower yeast and mold than the control (0.71±0.02 log cfu/g). Throughout the storage period yeast and mold count of T was lower than control. (Tables 2). Similar findings were observed by Nath *et al*. (2016) in chicken nuggets during frozen storage. Coliform were not detected in the treatment as well as control during storage period.

Table 1: Effect of green coffee extracts incorporation on Microbiological properties of chevon nuggets during Frozen storage (Mean±SE)

Days/Group	0	15	30	45	60	Treatment Mean±SE
Total plate count						
C	2.21±0.03^{h}	2.44±0.02^{f}	2.66±0.02^{d}	2.83±0.03^{c}	3.17±0.03^{a}	2.66±0.01^{A}
T	2.19±0.02^{h}	2.32±0.02^{g}	2.57±0.04^{e}	2.77±0.03^{d}	2.95±0.03^{b}	2.56±0.01^{B}
Days Mean±SE	2.20±0.01^{T}	2.38±0.01^{S}	2.62±0.01^{R}	2.80±0.01^{Q}	3.06±0.01^{P}	

	Psychrophilic count					
C	ND	1.63±0.03^{g}	2.05±0.02^{e}	2.63±0.03^{c}	2.92±0.05^{a}	1.84±0.01^{A}
T	ND	1.62±0.02^{g}	1.93±0.03^{f}	2.42±0.03^{d}	2.79±0.04^{b}	1.75±0.01^{B}
Days Mean±SE	0.00±0.00	1.63±0.03^{S}	1.99±0.03^{R}	2.53±0.03^{Q}	2.85±0.03^{P}	
	Total Yeast and Mold count					
C	ND	ND	ND	1.69±0.05^{c}	1.87±0.06^{a}	1.84±0.01^{A}
T	ND	ND	ND	1.54±0.08^{d}	1.74±0.07^{b}	1.75±0.01^{B}
Days Mean±SE	0.00±0.00	0.00±0.00	0.00±0.00	1.61±0.01^{Q}	1.80±0.01^{P}	

For each trait, means with different superscript within each column and each row differed highly significantly ($P<0.01$), significantly ($P<0.05$) C=control, T= green coffee extract n=6 (for each treatment)

4. Conclusions

The results clearly demonstrate the antioxidant effect of GCE in chevon nuggets during frozen storage. The extract effectively improved microbiological quality than control. Thus, green coffee could be successfully used to extend the

shelf life of Frozen meat products.

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