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Improvement of Physico-chemical features of Chevon nuggets by Walnut (*Juglans regia*)

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Abstract
The present study was undertaken to evaluate the possibility of utilization of walnuts in the development of value added healthier chevon nuggets and to study their physico-chemical, properties. Walnut were used at 0, 5, 10 and 15% to replace lean meat in the formulation. The chevon nuggets developed were assessed for various physicochemical. Chevon nuggets containing optimum (10%) levels of walnut were selected for studied and the optimized nuggets were aerobically packaged in low density polyethylene pouches with density value of 0.930 g/cm^3 along with control (0% levels of walnut) and evaluated Physicochemical parameters for 21 days under refrigerated conditions (4±1 ºC). Based on various parameters of physicochemical a 10% level of walnuts was adjudged as optimum for the preparation of walnut enriched chevon nuggets. Both walnut enriched optimized nuggets and control were successfully stored for 7 days under refrigerated conditions (4±1 ºC) without marked loss in storage quality.

Keywords: Chevon, nuggets, refrigerated storage, walnuts

Introduction
The potential for value-addition in meat can be well acknowledged considering that demand for meat has been growing strongly ever since the dawn of 21st century due to the factors like industrialization and globalization which stimulated growth of per capita income (Deogade *et al*., 2008) [12]. Diet may not be the only factor determining well-being and health, but it is certainly one of the most important, and therefore there is increasing demand for safer and healthier foods. A promising approach to improve health care would be to produce a healthier food supply as a preventive health care strategy (Decker and Park, 2010) [12]. There is a growing evidence that regular consumption of nuts is associated with a variety of health promoting effects and to date there are no adverse effects reported even with high nut intake (Fischer *et al*.,2013) [14]. Walnuts are rich in dietary fibre (6.7%), unsaturated fatty acids (70% of total fatty acids), minerals (2%) and polyphenols (51.4-58.2 mg gallic acid equivalents GAE/g FW) and are increasingly associated with an overall healthy lifestyle and reduced risk of disease (Akbaraly *et al*., 2011; Bemstein *et al*., 2011, Rabrenovic *et al*., 2008, Chen and Blumberg 2008) [21, 1, 5]. Vegetables like brinjal are also rich in antioxidants like phenols and its related compounds (Dar *et al*. 2015) [7] which provide antioxidant activity (Dar *et al*. 2014a, b; Dar *et al*. 2016a, b) [9, 6, 8, 11] as honey (Tlak Gajger 2015) [22] and deterrence to insect pests (Dar and Mir 2016) [6, 8, 11]. Recent studies by Manchester *et al.* (2000) [18] and Gonzalez Gomez *et al.* (2009) [15] have indicated that walnuts (*Juglans regia*) contain healthful constituents like melatonin (100ng/g) and serotonin (9.8ng/g). Melatonin, an indolamin is effective in sleep-wake cycle so its consumption may be an effective and natural way to regulate sleeping disorders (Wassmer and White-house, 2006) [31]. It is also a potent free radical scavenger and broad-spectrum antioxidant (Perumal, 2003) [20]. Serotonin is a neurotransmitter that regulates mood, apetite, sleep and improve health benefits in metabolic syndrome because of improvement in oxidation, inflammation and cardiovascular risk markers (Tulapani *et al*., 2011) [30]. Because of the evident health benefit, there is a need to study the importance of including a certain amount of walnut in human diets. In light of these considerations and the nutritional profile defined, the present study was undertaken to analyse the quality attributes of walnut enriched chevon nuggets and to study the effect of refrigeration on the storage quality of developed nuggets.

Material and Methods

Procurement of materials for the preparation of chevon nuggets

Leg cut of adult Bhakarwal goat carcass slaughtered by ritual method was purchased from the local market in the vicinity of SKUAST Jammu. The lean meat was obtained after deboning and trimming the fat manually. The lean meat so obtained was packed in LDPE pouches and stored at standard freezing temperature (-18 ± 2^0C) until it was used. Commercially available refined vegetable oil containing energy (900 Kcal/100 gram), saturated fatty acids (14g %) and cholesterol 0%was used in emulsion preparation. Condiments paste used contained fresh onion, garlic and ginger in the ratio of 3:2:1. The spice mix formula was standardized in the laboratory. The dried walnuts were obtained from local market of Srinagar. The shells of these nuts were removed manually and the kernels were ground in powder form and packed in polythene bags and refrigerated at 4 ± 1^0C.

Preparation of chevon nuggets

Lean meat was cut into smaller pieces and minced twice in a mincer (Marsango, Italy). The formulation for the preparation of chevon nuggets was earlier standardized through preliminary trials and contained lean meat 68%, added water 9%, vegetable oil 8%, condiment mixture 3%, refined wheat flour 4%, whole egg liquid 2.5%, spice mixture 2.5%, common salt 2%, sugar 0.5%, monosodium glutamate 0.3%, sodium hexametaphosphate 0.2% and sodium nitrite 120ppm. Meat emulsion was prepared by using Bowl chopper [Marsango, Italy]. The batter so obtained was moulded in oil coated rectangular stainless steel boxes and cooked for 30±2 minutes after first steam. The boxes were allowed to cool at room temperature after removal from pressure cooker. The brick shaped chevon block so obtained was cut into nuggets.

Physico-chemical Properties

The pH of chevon nuggets was estimated by using a digital pH meter (Systronics Digital pH Meter 803) as per Keller *et al.* (1974) [17]. The proximate composition *viz*. moisture, crude protein, crude fat and ash contents in both treatment samples and control was determined by using standard procedures (AOAC 2000). Emulsion stability of meat emulsion was determined as per the method of Townsend *et al*. (1968) [29]. The weight of product was recorded before and after cooking and cooking yield was calculated as a percentage.

Results and Discussion

Physicochemical characteristics

The mean values of various physicochemical parameters namely pH, proximate composition, emulsion stability and cooking yield of chevon nuggets incorporated with 0, 5, 10 and 15 percent levels of walnut (*Juglans regia*) are given in Table-1.

pH and proximate composition

Addition of walnut caused slight but non-significant (P>0.05) increase in pH values of cooked chevon nuggets. Similar results have been reported for the influence of walnut upon the pH of restructured beef steaks with added walnut. These results are also consistent with the findings in healthier frankfurters added with walnut (Ayo *et al.,* 2005) [2]. It has also been reported that increasing the amount of walnuts, while keeping the meat protein content constant, had no significant effect on the pH of meat batters. There was a gradual decrease in moisture content (56.15±1.28%) at 10% levels of chevon nuggets with increasing levels of walnut incorporation. Mostafa (2013) on the basis of his findings on evaluation of selected nuts and their protein functional properties reported about 1.1% moisture level in walnut kernels. So, lesser moisture content in walnut incorporated chevon nuggets is most probably attributed to the reported lesser moisture values in walnuts. Similar results were recorded in case of restructured beef steaks with added walnuts. Protein content of chevon nuggets prepared by incorporating different levels of walnut followed a non-significant (P>0.05) variation but was comparable to that of control. The results obtained were in consonance to the results obtained in case of restrctured beef steaks with added walnuts. The fat content of chevon nuggets prepared by incorporating different levels of walnut was significantly (P<0.05) higher as compared to control. The increase in fat content of chevon nuggets incorporated with walnuts is attributed to the higher levels of fat (50-72%) in walnut kernels (Periera *et al.,* 2008) [19]. Hydrolysis of proteins and other biochemicals in insects e.g. bees were hurdled during disease and pest attack. However some reports from European countries showed that protein digestion and metabolism is impaired due to various diseases (Tlak Gajger *et al*. 2011a, Tlak Gajger *et al*. 2014a,b) [24, 25, 27] and pests in bees and other animals. The administration of the certain proteins, fatty acids and herbal preparations (Tlak Gajger, 2011b) [23] were found suitable for midgut activity in bees (Tlak Gajger *et al*. 2013a, b) [26]. Hence, increase in the levels of walnut incorporation in chevon nuggets are associated with increase in fat content of the products. Ash content of chevon nuggets prepared by incorporating different levels of walnut was significantly (P<0.05) higher at 10% and 15% levels as compared to control. These results were consistent with other findings in meat batters with different levels of walnut (Ayo *et al*., 2005) [2]. The increase in the ash content can be attributed to the fact that added walnuts contain appreciable amount of minerals (1.7%).

Emulsion stability and cooking yield

Chevon nuggets prepared by incorporating different levels of walnut presented significantly (P<0.05) higher values of emulsion stability and cooking yield than control (Table-2). Walnut has been reported to increase the ability of the protein matrix to retain water and bind fat, hence providing a possible reason of improvement in emulsion stability and cooking yield in walnut enriched chevon nuggets (Jimenez-Colmenero *et al*., 2003) [16]. Earlier studies reported a reduction in cooking loss, but significantly only when 10% or more of walnut was added. However, in contrast some authors have reported increased cooking loss as the fat content increases but others have reported no such findings (Blackmer *et al*., 1997) [4].

Table 1: Effect of different levels of walnut on physico-chemical parameters of cooked chevon nuggets (Mean± SE)*

Parameters	Levels of walnut (%)			
	0	5	10	15
pH	6.17 ± 0.07^{a}	6.39 ± 0.13^{a}	6.37 ± 0.05^{a}	6.47 ± 0.13^{a}
Moisture	59.64 ± 0.53^{a}	57.81 ± 0.865^{ab}	56.15± 1.28^{bc}	53.31± 1.23^{c}
Protein	17.57± 0.26^{a}	18.47± 0.38^{ab}	18.81± 0.4^{b}	19.06 ± 0.52^{b}
Fat	9.76 ± 0.35^{a}	11.59 ± 0.53^{b}	13.09 ± 0.31^{c}	13.92 ± 0.54^{c}
Ash	1.55 ± 0.08^{a}	1.80 ±0.06^{ab}	2.14 ±0.15^{bc}	2.19 ±0.12^{c}
Emulsion stability	80.34±1.09^{a}	83.66±0.80^{b}	84.01±0.95^{b}	83.62±0.83^{b}
Cooking yield	81.10 ± 0.84^{a}	83.57 ± 0.54^{b}	84.08 ± 0.35^{b}	83.07 ± 0.54^{b}

***** Mean ± SE with different superscripts in a row differs significantly (P<0.05).n=6 (six observations)

Table 3: Effect of refrigeration storage on the physico-chemical characteristics of chevon nuggets incorporated with optimum levels of almond and walnut aerobically packaged in LDPE films and stored in refrigerator. (Mean ±SE)*

Treatment	Storage period in days			
	0	7	14	21
pH				
CONTROL	6.17 ± 0.027^{Aa}	6.26± 0.021^{Ab}	6.36± 0.015^{Ac}	6.47± 0.034^{Ad}
WL	6.20±.016^{Aa}	6.31±.107^{Bb}	6.43±0.010^{BCc}	6.53±0.01^{Bd}
TBARS (mg malonaldehyde/kg)				
Control	0.347± 0.001^{Aa}	0.722±0.002^{Ab}	1.03 ± 0.016^{Ac}	1.29 ± 0.016^{Ad}
WL	0.335±0.008^{Aa}	0.708±0.005^{Bb}	1.01±.032^{Ac}	1.21±0.020^{Bd}
FFA(% oleic acid)				
Control	0.087±0.001^{Aa}	0.127±0.001^{Ab}	0.211 ± 0.001^{Ac}	0.363 ± 0.001^{Ad}
WL	0.074±0.001^{Ba}	0.116±0.001^{Db}	0.201± 0.001^{Bc}	0.356± 0.001^{Bd}

*Mean± SE with different superscripts in a row wise (lower case alphabet) and column wise (upper case alphabet) differ significantly (P<0.05).. WL= walnut incorporated chevon nuggets. n=6 (six observations) for each treatment.

Conclusions

The present study showed that the reformulation of chevon nuggets with added walnut in order to develop healthier cooked meat products, altered their physicochemical properties but the resulting product possessed acceptable physicochemical and sensory properties when compared with control nuggets. On the basis of analysis of different physico-chemical parameters 10 percent of walnut was optimum for making functional chevon nuggets produces the product of high acceptability.

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