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Effect of incorporation of lemongrass oil on the quality characteristics of chicken nuggets

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Abstract
An experiment was conducted to study the quality characteristics of chicken nuggets by incorporation of lemongrass oil. Chicken nuggets were prepared by incorporating lemongrass oil at three different levels (0%-control, 0.01% - treatment I, 0.05% - treatment II, 0.1% treatment III). The products were evaluated for various physico - chemical parameters and sensory parameters to find the optimum level of incorporation of lemongrass oil in the chicken nuggets. The result showed that the emulsion pH, product pH, emulsion stability, product yield, shear force value, moisture and fat retention did not show any significant difference between the treatments and control. The DPPH scavenging activity and phenolic content of lemongrass essential oil was observed to be significantly (P<0.05) increasing with increasing concentrations, highest value being observed in 0.1%. Sensory evaluation of the nuggets revealed significant (P<0.05) difference in flavour and spiciness scores between treated and control nuggets. Thus it can be concluded that 0.05% level of inclusion of lemongrass oil can be effectively used for preparation of chicken nuggets of an acceptable quality.

Keywords: essential oil, lemongrass, chicken nuggets, physico-chemical, sensory quality

Introduction
Meat and meat products are prepared in various forms and conveniences to suit the consumer's choice. Today's consumers prefer more nutritious and convenient ready to eat meat products. These convenient items must be economical and cost effective besides better in shelf life, quality and acceptability than traditional products. Value added meat products are further processed meat products with increasing convenience to the consumer through decreasing preparation time and minimizing preparation steps. With the advent in processing and availability of new product meat consumption, particularly poultry meat consumption has increased many folds all over the world.

Value added meat products could be broadly classified based on processing methods as emulsion meat products, restructured meat products, ground meat products, enrobed meat products and fermented meat products. A large variety of emulsion based meat products include sausages, patties, nuggets, kebabs and meat balls. Meat nuggets are ready to eat convenient meat product which is obtained by cutting cooked and cooled rectangular or cubical shape meat loaves into approximately 4cm ×1.5cm × 1.5cm pieces. The product can be packed in unit pouches and stored at 4 ºC for week.

Meat products are highly perishable products and easily become unfit for human consumption possibly due to microbial growth, chemical changes and break down by endogenous enzymes. They also undergo rapid changes chiefly lipolysis and proteolysis leading to sensory deterioration and high risks of food borne pathogens (Casaburi *et.al.,* 2011) [3]. Many strategies exist to preserve their safety and quality such as super chilling, chemical preservatives, high hydrostatic pressure, active packaging, natural preservatives and nano particles. Each of the above strategies contributes in retention of physico – chemical, sensory and microbiological characteristics. But each preservation technique has some characteristic deficiencies. Chemical preservatives such as sodium acetate, sodium nitrate, potassium sorbate, butylated hydroxy anisole are the most effective approach till now, but many of them have been found to induce neural toxicity and tumorigencity.

Chemical preservatives however, are not preferred now -a -days due to their residual effect and declining consumer preference. Concern over the negative perception of consumers on chemical preservatives has motivated processing industries to pursue and develop natural preservatives that offer safer alternatives. In recent years, consumers are increasingly focused on the use of natural products and natural substances, especially of plant origin rather than

synthetic preservatives because of their potential toxicological effects (Naveena, *et al*., 2008) [10]. Among the natural substances essential oils from spices are the most appropriate and promising substances, used in meat products to enhance its sensory and microbial quality. Essential oils are the volatile, natural, aromatic oily liquids extracted from plant materials, such as leaves, fruits, seeds and barks. They are characterized by a strong odour and are formed by plants as secondary metabolites (Burt, 2004) [2].

They have shown remarkable antimicrobial activity even at low concentrations, they do not cause microbial resistance and undesired changes in meat products. So they are generally recognized as safe (GRAS) and commonly accepted by consumers. In addition to antimicrobial property, essential oils also have antioxidant, antimycotic, antitoxigenic, antiviral and insecticidal action. The main component responsible for the antioxidant antimicrobial properties of essential oils are the phenolic compounds such as timol and carvacol etc., Essential oil apt for edible purpose are oregano, mint, rosemary, lemongrass orange, sage, clove, lavender, cumin, thyme, balm etc.,

Lemongrass (*Cymbopogon citratus*) a tall perennial grass comprising of about 55 species, is native to warm region and grows in almost all tropical and subtropical countries (Cheel *et al*., 2005) [4] It is an aromatic herb known in the north and west tropical Africa, in Arabian peninsula and in Egypt (Khadri *et al*., 2010) [8]. The antioxidant activity of lemongrass oil was due to the synergistic actions of such as monoterpenoid compounds such as α–citral, β-citral, myrcene (Ruberto and Barrata, 2000) [13] and eugenol (Rathabai and Kanimozhi, 2013) [11]. These phenolic compounds may act as metal chelators, free radical scavengers, hydrogen donators and inhibitors of the enzymatic systems responsible for initating oxidation reaction. Therefore, the aim of this study was to evaluate the effect of lemongrass essential oil as an antioxidant agent on the quality characteristics of chicken nuggets.

Materials and methods

Raw Materials

Dressed broiler carcasses were purchased from the retail outlets and the carcass was hygienically deboned and trimmed off all visible adipose and connective tissues. The deboned meat was minced through an 8-mm plate using a meat mincer and stored at -18±2 ºC in low-density polyethylene (LDPE) packs for further use.

Nugget Ingredients

The certified food grade lemongrass essential oil purchased from M/s. Akay Flavour and Aromatics Pvt. Limited, Kochi. Commercially available food grade ingredients available in the local market were purchased and used. Chicken nuggets were formulated with the addition of lemongrass essential oil at 0.01%, 0.05% and 0.1% along with a control. The ingredients added other than broiler meat and lemongrass essential oil were maida (3%), vegetable oil (5%), salt (2%), condiment mix (7.5%), spice mix (3%) and slushed ice (5%).

Nugget preparation

The emulsion was prepared by adding of minced meat with salt and other ingredients of the formulation in a sequential order at a specified time interval. During chopping, the temparture of the emulsion was maintained at 10 to 12 ºC by the addition of slushed ice.

For the preparation of nuggets, about 350gm of emulsion was tightly filled in stainless steel mould, which was steam cooked for 40-45 minutes to reach the internal temperature of 80±2 ^{0}C. After cooking, the mould was removed from steam cooker and cooled at room temperature. Nuggets were prepared by cutting meat block into small cubes with the help of meat slicer. Then the nuggets were cooled to room temperature and packed according to the individual experiment needs for further physico-chemical and sensory evaluation by using 8 point descriptive scale (Keeton, 1983) [7], where 8 denoted extremely acceptable, 1 denoted less acceptable.

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 test was done for comparing the means. Means and standard error were calculated following the standard statistical procedures. Each experiment was replicated thrice and the samples were analysed in duplicate except for the sensory scores. In significant effects, least significant differences were calculated at appropriate level of significance (0.05) for comparison of treatment means.

Results and Discussion

Physico-chemical parameters such as emulsion pH, product pH, emulsion stability, product yield, shear force value, moisture and fat retention and DPPH scavenging activity were assessed and detailed sensory analysis for various sensory attributes namely general appearance, flavour, spiciness, juiciness, texture and overall acceptability were evaluated to find the optimum level of incorporation of lemongrass essential oil. The physico-chemical characteristics of chicken nuggets incorporated with different levels of lemongrass essential oil are presented in Table1

Physico-chemical characteristics: (Table -1)

Inclusion of lemongrass oil did not influence the emulsion pH, product pH which was similar to the results of Ibrahim *et al*. (2013) [6] in chicken patties. Upon cooking the pH of the chicken nuggets increased markedly over the emulsion pH. Similar result was observed in chicken meat balls by Arun Prabhu (2014). Lemongrass oil added in different levels during the emulsion preparation did not reveal any significant effect on emulsion stability and cooking yield of the products. Similar findings were reported by Rathod (2015) [12] who has observed no significant changes in emulsion stability and cooking yield in lemon peel treated chicken nuggets.

Shear force value of treated nuggets decreased gradually with increase in the inclusion levels of lemongrass oil though not statistically significant. However, there was no significance between the three incorporation levels of lemongrass oil.

The moisture retention of chicken nuggets also increased with increased level of incorporation of lemongrass oil which recorded higher value at 0.1% level. However, there was no significant difference between treatments. Lemongrass oil with 0.01% level of incorporation recorded lower value for moisture retention compared to other two treatments.

The fat retention of chicken nuggets was also increased with increased level of incorporation of lemongrass oil which recorded higher value at 0.1% level. However, there was no significant difference between treatments. Lemongrass oil with 0.01% level of incorporation recorded lower value for fat retention compared to other two treatments.

The antioxidant activity of lemongrass oil (LO) was significantly (P≤0.05) pronounced with increasing concentration of oil and also in the product as revealed by statistical difference between control and treated nuggets though there was no statistical difference between treated nuggets. The antioxidant activity of lemongrass oil was due to the synergistic actions of such as monoterpenoid compounds such as α–citral, β-citral, myrcene (Ruberto and Barrata, 2000) [13] and eugenol (Rathabai and Kanimozhi, 2013) [11]. These phenolic compounds may act as metal chelators, free radical scavengers, hydrogen donators and inhibitors of the enzymatic systems responsible for initating oxidation reaction. Similar finding was reported by Mielnik *et al*. (2008) [9] and Sayago-Ayerdi *et al*. (2009) in turkey thigh and in chicken hamburgers respectively.

Total phenolic content of chicken nuggets increased with increasing level of concentration of essential oil.This result was in concurrent with Rathod (2015) [12] who found that similar result in lemon peel and lemon pulp incorporated chicken nuggets.

Sensory characteristics: (Table -2)

In the sensory evaluation, the scores for appearance, texture, juciness, mouth coating and overall acceptability did not vary with the addition of Lemongrass oil. Flavour and spiciness scores of the 0.01% and 0.05% treatments were comparable with that of the control whereas the scores were significantly (P<0.05) lower for the 0.10% treatment. Similar to this, Sojic *et al*. (2015) [17] found that the aroma of the cooked sausages with nutmeg oil at 10 ppm and 20 ppm levels were not affected. The results were in accordance with that of Babu *et al*. (2012) [1], who observed a significant (P<0.05) decrease in flavour scores in chicken patties formulated with clove oil at various concentrations of 1: 250, 1:500 and 1:1000.The spiciness score was significantly (P<0.05) higher for the 0.01% treatment when compared to the control and other treatments. Inclusion of spices in cooked ground beef significantly (P<0.05) increased the spice flavor intensity (Dwivedi *et al*.2006) [5].

Conclusion

Nowadays the consumers give immense importance for their health and safety. Presently, there is increased consumption of ready to eat processed meat products which contain chemical preservatives used for desired sensory attributes and extending the shelf life and it is imperative to curtail these ingredients. Hence the combination of essential oils may be used as a natural preservative in meat products would be a better choice. In addition, various preservation techniques can be combined with the use of the essential oils. From the results of this study showed that DPPH scavenging activity of Lemongrass essential increased with increasing concentration of essential oil, which showed higher antioxidant property. But at higher concentration of Lemongrass essential oil incorporated chicken nuggets are not organoleptically acceptable because of its strong pungency. Hence, adding Lemongrass essential oil at 0.05% gives better antioxidant property and they were organoleptically acceptable.

Table 1: Mean (±S.E.) values of physico-chemical parameters of Lemongrass oil (LO) incorporated chicken nuggets

Quality parameters	Control	LO 0.01% (T_1)	LO 0.05% (T_2)	LO 0.1% (T_3)
Emulsion pH	6.10±0.02	6.13±0.02	6.14±0.03	6.16±0.02
Product pH	6.19±0.02	6.20±0.02	6.20±0.03	6.23±0.03
Emulsion stability (%)	93.86±0.42	94.51±0.61	94.43±0.46	94.62±0.50
Product yield (%)	92.99±0.37	93.45±0.53	93.31±0.43	93.54±0.38
Shear force (kg/cm^2)	0.59±0.04	0.57±0.03	0.55±0.04	0.52±0.03
Moisture retention (%)	68.37±0.69	69.10±0.97	69.41±0.86	69.73±0.77
Fat retention (%)	76.51±1.22	77.06±0.70	78.20±0.94	78.14±1.08
DPPH scavenging activity of TO (%)	-	31.46^a±0.26	37.93^b±1.55	41.95^c±1.86
DPPH scavenging activity of TO in product (%)	18.37^a±1.8	24.52^b±1.94	28.86^{bc}±1.81	31.62^c±1.66
Total phenolic content of TO in product (µg/gm)	601.17^a ±5.43	612.17^{ab} ±5.60	618.83^b ±5.31	636.83^c ±3.87

*Mean ± S.E with different superscripts between columns differ significantly (P<0.05). n=6 of each treatment.

Table 2: Mean (±S.E.) values of sensory attributes of Lemongrass (LO) incorporated chicken nuggets

Sensory attributes	Control	LO 0.01% (T_1)	LO 0.05% (T_2)	LO 0.1% (T_3)
Appearance	6.46±0.10	6.46±0.10	6.37±0.11	6.32±0.12
Flavour	6.10^b±0.09	5.85^{ab}±0.16	5.75^{ab}±0.13	5.46^a±0.16
Spiciness	6.00^b±0.14	5.73^{ab}±0.13	5.52^a±0.16	5.35^a±0.17
Texture	6.4±0.06	6.44±0.06	6.46±0.11	6.30±0.05
Juiciness	6.18±0.04	6.17±0.06	6.15±0.15	5.90±0.09
Overall acceptability	6.27±0.10	6.25±0.08	6.07±0.11	5.98±0.11

*Mean ± S.E with different superscripts between columns differ significantly (P<0.05). n=21 of each treatment.

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