

Full Length Research Paper

Utilization of clove powder as phytopreservative for chicken nuggets preparation

Devendra Kumar* and V. K. Tanwar

Department of Livestock Products Technology, College of Veterinary and Animal Science, G.B. Pant University of Agriculture and Technology, Pantnagar-263145, India.

Accepted 14 December, 2010

An investigation was undertaken to explore the possibilities of utilization of clove powder as phyto-preservative in chicken nuggets prepared from spent hen meat and then storage study was conducted at $4\pm 1^\circ\text{C}$, to assess the effect of test ingredient (clove powder) on sensory and microbiological qualities of optimized product in comparison with its control counterpart. Addition of clove powder in standard formulation caused a slight change in emulsion stability, cooking yield, water activity and composition of chicken nuggets. The findings showed antimicrobial effect of clove powder as microbial load in optimized preparation was found to be significantly ($P\leq 0.05$) lower throughout the storage period when compared with control preparation. Sensory scores of optimized and control preparation were found to be acceptable even after 15 days of storage.

Key words: Clove, phyto-preservative, chicken nugget, storage stability.

INTRODUCTION

Utilization of spices in various forms like powder, extract or essential oils has been well documented for inhibiting the growth of many spoilage bacteria and fungi in foods (Meena and Sethi, 1997; Subbulakshmi and Naik, 2002; Rajkumar and Berwal, 2003). Clove (*Eugenia caryophyllus*) is reported to have antibacterial (Everting and Deibel, 1992; Suresh et al., 1992), antimycotic (Karapinar, 1990; Illicim et al., 1998) and yeast inhibitory (Frag et al., 1989) activity. Such properties of clove may be attributed to its 2-methoxy-4-(2-propenyl) phenol content (Beuchat and Golden, 1989 and Suresh et al., 1992).

The basic approach in developing convenience meat products for the Indian market must be governed by consideration of cost. Hence, the choice of meat falls on the low-graded meat like that of culled and spent hens, which can be upgraded with functional food additives into good quality value added products. Lipid oxidation is one of the major causes of deterioration in the quality of meat and meat products. It may also decrease the nutritional

value by forming potentially toxic products during cooking and processing (Shahidi et al., 1992; Maillard et al., 1996). Clove also possesses good antioxidant activity (Gulcin et al., 2004). Therefore, an investigation was undertaken to evaluate the effect of incorporating clove powder on physico-chemical, sensory and storage stability of chicken nuggets prepared from spent hen meat.

MATERIALS AND METHODS

Procurement of the materials

The spent hens were procured from Instructional Poultry Farm (IPF), Govind Ballabh Pant University of Agriculture and Technology, Pantnagar. The birds were slaughtered and dressed, manually de-boned, packed in low density polyethylene (LDPE) bags and stored overnight at $4 \pm 1^\circ\text{C}$ in refrigerator. The ingredients of spice mix were procured from Pantnagar local market, cleaned and dried in oven at 50°C for 2 h; grounded and sieved through 100 mesh and the fine powder obtained was stored for subsequent use. The condiment mix contained onion, garlic and ginger; prepared afresh in appropriate ratio as fine paste. Clove buds, refined soybean oil, refined wheat flour, table salt, sugar, skim milk powder and eggs were procured from Pantnagar local market. Clove buds were cleaned and ground to fine powder and stored in air-tight

*Corresponding author. E- mail: drdevvet24@rediffmail.com, drdev24@gmail.com.

containers at room temperature ($24 \pm 2^\circ\text{C}$) for subsequent use.

Preparation of chicken nuggets

Meat was cut into small pieces and grounded twice in a meat mincer (Hobart®, USA) with 5 mm plate followed by 3 mm plate. Emulsion of each formulation was prepared using bowl chopper (Hobart®, USA). All the nugget formulations consisted of spent hen meat 60%, vegetable oil (fat) 10%, ice flakes 10%, refined wheat flour 2.5%, skim milk powder 2%, whole egg liquid 5%, table salt 2%, sugar 1%, sodium tri-polyphosphate (STPP) 0.25%, condiments 5%, spices mix 1.5% and sodium nitrite 150 ppm. The prepared emulsion was tightly packed in oil coated metallic mold fitted with lids and steam cooked for 45 min at 34.47 KN/m^2 pressure. Subsequently, the cooked product was cooled, weighed and removed carefully from the moulds. The meat block thus obtained was carefully sliced and cut in nugget size pieces ($4 \times 1.5 \times 1.5 \text{ cm}$). The nuggets were packed in sterilized LDPE bags and stored at refrigerated temperature ($4 \pm 1^\circ\text{C}$) for analysis.

Optimization of clove powder

The meat emulsion for control product consisted of basic formulation given earlier without test ingredient. Clove powder was added to the earlier formulation at three levels – 0.1, 0.2 and 0.3% (w/w) of meat emulsion. The preliminary trials were conducted to access the best level of incorporation of clove powder into chicken nuggets, on the basis of sensory evaluation by semi-trained sensory panel of 11 panelists. On the basis of sensory evaluation, chicken nuggets containing 0.1% clove powder were selected for further study.

Physico-chemical characteristics

The emulsion stability was determined by the method of Baliga and Madaiah (1970) with minor modifications (50 g emulsion was taken in LDPE bags). The pH value was recorded by using a digital pH meter (ECI Ltd, India) and water activity by using water activity meter (Rotronic Hygrolab 3). Thiobarbituric acid (TBA) value (mg malonaldehyde/kg of sample) was estimated as per procedure given by Tarladgis et al. (1960). Moisture, protein, fat and total ash content of chicken nuggets were determined following AOAC (1984) procedures. Total Plate count (TPC), total lipolytic, coliform and yeast and mold counts were done by following standard methods of APHA (1992). The sensory quality of samples was evaluated using 8 point hedonic scale (Keeton et al., 1984) using semi-trained sensory panel of 11 panelists.

Storage study

Storage study of product was conducted by keeping the products at $4 \pm 1^\circ\text{C}$ for 15 days. Sensory evaluation, pH and TBA values estimation and microbiological study were conducted on both preparations, control as well as the optimized one, after every 5 days of interval. Data were recorded and statistically analysed to evaluate the stability of optimized product in comparison to control preparation.

Statistical analysis

Statistical analysis of the data was done using ANOVA technique according to the method described by Snedecor and Cochran (1994) on completely randomized design (CRD). Average of three

Table 1. Effect of clove powder¹ on physico-chemical properties of chicken nuggets (Mean \pm SE).

Parameters	Control	Optimized product
Emulsion stability	94.375 \pm 0.311	94.478 \pm 0.301
Cooking yield	95.835 \pm 0.232	96.083 \pm 0.098
Water activity	0.972 \pm 0.0026	0.974 \pm 0.0026
Moisture	62.031 \pm 0.192	62.037 \pm 0.238
Protein	15.354 \pm 0.422	15.173 \pm 0.405
Fat	13.093 \pm 0.310	12.783 \pm 0.125
Total ash	2.764 \pm 0.041	2.730 \pm 0.033

¹Clove powder is added in the formulation at 0.1% level (w/w) of meat emulsion.

replicates was used in calculations.

RESULTS AND DISCUSSION

Physico-chemical characteristics

Table 1 indicated that incorporation of clove powder in chicken nugget formulation caused slight increase in emulsion stability, moisture content and water activity, whereas a slight decrease in cooking yield, protein, fat and total ash content were observed after incorporation. However, statistically all these changes were non-significant.

Effect on sensory parameters

Sensory evaluation of all prepared samples presented in Table 2 indicated that, chicken nuggets containing clove powder scored significantly ($P < 0.05$) higher for appearance/colour, flavour, juiciness and overall acceptability than the control preparation while texture scores remained unaffected statistically. The better appearance/colour scores of optimized nuggets might be due to a slight reddish tint imparted by clove powder. Decrease in flavour scores might be due to development of oxidative rancidity and microbial deterioration in products during storage. All sensory scores decreased significantly ($P < 0.05$) with the advancement of storage period. Biswas et al. (2006) also reported that all the sensory quality values decreased significantly with the advancement of storage period.

Effect on pH and TBA value

A non-significant effect on pH value was observed in the nuggets after clove powder incorporation, but a significantly ($P \leq 0.05$) increasing trend in pH value was observed in both preparations with the advancement of

Table 2. Effect of clove powder¹ and storage period on quality attributes of chicken nuggets (Mean \pm SE).

Product (Treatments)	Storage period (No. of days)				Treatment mean
	0	5	10	15	
Appearance/Colour					
Control	6.812 \pm 0.148	6.720 \pm 0.149	6.020 \pm 0.092	4.940 \pm 0.248	6.123 \pm 0.423b
Optimized	7.236 \pm 0.113	7.112 \pm 0.090	6.850 \pm 0.079	6.252 \pm 0.085	6.862 \pm 0.219a
Flavor					
Control	6.878 \pm 0.126	5.600 \pm 0.169	3.652 \pm 0.202	3.532 \pm 0.092	4.915 \pm 0.808b
Optimized	7.374 \pm 0.112	5.402 \pm 0.101	4.880 \pm 0.145	4.528 \pm 0.149	5.546 \pm 0.689a
Texture					
Control	.630 \pm 0.119	6.500 \pm 0.106	6.234 \pm 0.085	5.450 \pm 0.101	6.203 \pm 0.264b
Optimized	6.470 \pm 0.078	6.324 \pm 0.049	6.180 \pm 0.068	5.980 \pm 0.129	6.238 \pm 0.105b
Juiciness					
Control	6.378 \pm 0.077	6.250 \pm 0.081	6.044 \pm 0.118	5.820 \pm 0.122	6.123 \pm 0.122b
Optimized	6.580 \pm 0.076	6.390 \pm 0.058	6.160 \pm 0.046	6.000 \pm 0.069	6.264 \pm 0.114a
Overall acceptability					
Control	7.100 \pm 0.127	6.460 \pm 0.147	5.340 \pm 0.136	4.220 \pm 0.082	5.780 \pm 0.635b
Optimized	7.404 \pm 0.084	6.850 \pm 0.135	6.080 \pm 0.051	5.780 \pm 0.073	6.437 \pm 0.302a
pH					
Control	6.128 \pm 0.0058B	6.160 \pm 0.0094A	6.234 \pm 0.0074C	6.262 \pm 0.0073D	6.196 \pm 0.027b
Optimized	6.128 \pm 0.0058B	6.158 \pm 0.0066A	6.223 \pm 0.0176C	6.246 \pm 0.0097D	6.189 \pm 0.024b
TBA					
Control	0.347 \pm 0.003	0.724 \pm 0.030	1.097 \pm 0.047	1.387 \pm 0.038	0.889 \pm 0.226a
Optimized	0.344 \pm 0.004	0.380 \pm 0.012	0.575 \pm 0.022	0.677 \pm 0.020	0.494 \pm 0.079b
Total plate count					
Control	2.545 \pm 0.131	3.388 \pm 0.187	4.285 \pm 0.152	6.436 \pm 0.099	3.913 \pm 0.944a
Optimized	2.382 \pm 0.136	2.474 \pm 0.135	2.735 \pm 0.128	3.05 \pm 0.092	2.660 \pm 0.149b
Lipolytic count					
Control	2.1152 \pm 0.137	2.725 \pm 0.132	3.167 \pm 0.119	3.577 \pm 0.091	2.896 \pm 0.313a
Optimized	2.0891 \pm 0.119	2.143 \pm 0.152	2.255 \pm 0.129	2.436 \pm 0.099	2.231 \pm 0.076b
Coliform count					
Control	ND	ND	1.814 \pm 0.155	2.5478 \pm 0.070	1.090 \pm 0.647a
Optimized	ND	ND	ND	1.390 \pm 0.049	0.347 \pm 0.347b
Yeast and mold count					
Control	ND	ND	1.164 \pm 0.061	2.068 \pm 0.105	0.808 \pm 0.501a
Optimized	ND	ND	0.680 \pm 0.280	1.18 \pm 0.092	0.465 \pm 0.287b

*: Mean values bearing same superscripts column-wise and row-wise (alphabets) do not differ significantly ($P < 0.05$). ¹Clove powder is added in the formulation at 0.1% level (w/w) of meat emulsion.

storage period (Table 2). The increase in pH value during storage period suggests that, there was significant breakdown of meat protein on storage of the product. The

increase in pH value during storage of meat was also reported earlier (Yadav and Sanyal, 1999). Chicken nuggets containing clove powder (optimized product)

maintained significantly ($P \leq 0.05$) lower TBA values throughout the storage period. Lower TBA values in optimized product were due to the anti-oxidant properties of clove powder. The antioxidant effect of clove was also reported earlier (Gulcin et al., 2004; Shobana and Naidu, 2000).

Effect on microbial count

An increasing trend in microbial counts was observed in both preparations with the advancement of storage period (Table 2), but chicken nuggets containing clove powder maintained a significantly ($P \leq 0.05$) lower microbial counts (TPC, coliforms, lipolytic, yeast and molds) throughout the storage period than control preparation. Lower microbial count observed in nuggets containing clove powder suggested antimicrobial properties of cloves, which were also reported earlier by Suresh et al. (1992), Yadav (2005) and Rajkumar and Berwal (2003).

Conclusion

From the present study, it can be concluded that in preparation of chicken nuggets, clove powder can be used at 0.1% level (w/w) of meat emulsion with beneficial effect on physico-chemical and sensory qualities of the product. This product can be stored at refrigeration temperature ($4 \pm 1^\circ\text{C}$) for 15 days in LDPE bags with good acceptability.

ACKNOWLEDGEMENT

Authors are grateful to the Director of Research and Dean, Faculty of Veterinary Science, G.B. Pant University of Agriculture and Technology, Pantnagar for providing necessary facilities to carry out the above research work.

REFERENCES

- AOAC (1984). Official Methods of Analysis. 14th edn. Association of Official Analytical Chemists. Washington, D.C.
- APHA (1992). Compendium of Methods for the Microbiological Examination of Foods. 4th edn. C. Vandergrant and D.F. Splittstoesser. American Public Health Association, Washington, D.C., pp. 919-927
- Baliga BR, Madaiah N (1970). Quality of sausages emulsion prepared from mutton. *J. Food Sci.*, 35(4): 383-385.
- Beuchat LR, Golden DA (1989). Antimicrobials occurring naturally in foods. *Food Technol.*, 43: 134-142.
- Biswas S, Chakraborty A, Sarkar, S (2006). Comparison among the qualities of patties prepared from chicken broiler, spent hen and duck meats. *J. Poultry Sci.*, 43: 180-186.
- Everting WT, Deibel KE (1992). Sensitivity of *Listeria monocytogens* to spices at two temperatures. *J. Food Safety.* 12: 129-131.
- Farag RS, Daw ZY, Hewedi FM, El-Baroty GSA (1989). Antibacterial activity of some Egyptian spices essential oils. *J. Food Protection*, 52: 665-667.
- Gulcin I, At G, Beydemir U, Elmasta M, Lu ORK (2004). Comparison of antioxidant activity of clove_ (*Eugenia caryophyllata* Thunb) buds and lavender (*Lavandula stoechas* L.). *Food Chem.*, 87(3): 393-400.
- Illicic A, Digrak M, Bagei E (1998). The investigation of antimicrobial effect of some plant extracts. *Turkish J. Bio.*, 22: 119-125.
- Karapinar M (1990). Inhibitory effect of anethole and eugenol on growth and toxin production of *Aspergillus parasitius*. *Intern. J. Food Microbio.*, 10: 193-200.
- Keeton JT, Foegeding EA, Patina AC (1984). A comparison of non meat products, sodium tripolyphosphate and processing temperature effects on physical and sensory properties of frank furthers. *J. Food Sci.*, 49: 1462-1474.
- Maillard MN, Soum MH, Boivin P, Berset C (1996). Antioxidant activity of barley and malt- Relationship with phenolic content. *Lesbensm Wissen*, 29: 238-244.
- Meena MR, Sethi V (1997). Role of spices and their essential oils as preservatives and antimicrobial agents – A review. *Indian Food Packer*, 25: 38-45.
- Rajkumar R, Berwal JS (2003). Inhibitory effect of clove on toxigenic molds. *J. Food Sci. Technol.*, 40(4): 416-418.
- Shahidi F, Janitha PK, Wanasundara PD (1992). Phenolic antioxidants. *Crit. Rev. Food Sci. Nutr.*, 32: 67-103.
- Shobana S, Naidu KA (2000). Antioxidant activity_ of selected Indian spices . *Prostaglandins, Leukotrienes and Essential Fatty Acids*, 62(2): 107-110.
- Snedecor GW, Cochran WG (1994). *Statistical methods*. First east west press edition, New Delhi.
- Subbulakshmi G, Naik M (2002). Nutritive value and technology of spices: current status and future perspectives. *J. Food Sci. Technol.*, 39: 319-344.
- Suresh P, Ingel VK, Vijayalakshmi N (1992). Antibacterial activity of eugenol in compersion with other antibiotics. *J. Food Sci. Technol.*, 29(4): 254-257.
- Tarladgis BG, Watts BM, Younathan MT, Dugan LR (1960). A distillation method for the quantitative determination of malonaldehyde in rancid foods. . *J. Am. Oil Chem. Soc.*, 37: 44-48.
- Yadav AS (2005). Recent advances in bio- and phyto-preservation of meat. In: *Recent Advances in Poultry and Egg Processing and Quality Assessment of Poultry Products*, 2005. Aug. 29- Sept. 7, CARI Izatnagar, India, pp. 75-79.
- Yadav PL, Sanyal MK (1999). Development of livestock products by combination preservation technique. In: *Proceedings of National Seminar on Food Preservation by Hurdle Technology and Related Areas*, DFRL, Mysore, India, pp. 104-109.