Microbial quality of pork nuggets incorporated with fish flesh under refrigeration

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ABSTRACT

Meat nuggets were prepared with pork (80%) and fish flesh (20%) under standardized processing conditions and were stored under refrigeration in aerobically packaged conditions with control samples of control-I (100% pork) and control-II (100% fish flesh). The samples were taken at regular interval of 7 days and analyzed for the microbial quality. Total plate counts showed no significant difference between treatment and controls but showed increasing trend as storage period increased. The psychrotroph and coliform counts were not detected till 14th day in both controls and treatment but showed increasing trend as storage period increased further. Yeast and mold count were not detected till 21st day and on 28th day counts of treatment was lower than control II and higher than control I. The microbial counts of the product were within the permissible limits for aerobically packaged meat products. Thus based on microbial quality, the products were safe for consumption up to 28 days of refrigerated (4±1^{O}C) storage in LDPE pouches.

Keywords: pork, fish, meat nuggets, microbial quality

Pig farming is growing rapidly in India due to a high fecundity, prolificacy, short gestation period, fast growth rate, high feed conversion ratio and higher dressing percentage compared to all other livestock. The pork is grayish pink in colour but classified as red meat by United State Department of Agricultural (USDA). In recent years, there is a sharp decline in the popularity of red meat because of increase in incidence of cardiovascular diseases and obesity problems amongst the urbanized population. Fish flesh is higher omega-3 fatty acids contents viz eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). It also contains a higher proportion of beneficial omega-3 fatty acids than the meat animals. Omega-3 fatty acids are beneficial to the people who are at high risk of cardiovascular diseases. Fish is a

cheap source of protein with less saturated fatty acids as compared to other meat species with fine texture and less myoglobin content.

With growing demand of meat products, it is necessary to partly substitute red meat with white meat for the health conscious consumers. The incorporation of fish at the optimal level in pork nuggets may yield better results in terms of nutrition and economy, reduces the cost of meat products since the rates of fish in most of the Indian markets, by and large, are lower than the animal meats. Fish flesh incorporation in meat products by partial substitution in animal meat may result into lesser content of fat in the ultimate finished product and may become better from nutritional and health point of views and helps to improve the functional quality of meat products because of textural and binding properties.

The formulation of prepared meat nuggets with standardized pork and fish flesh was quiet indicative of perishable nature because of high carbohydrate, protein and moisture content. The increase in microbial count and loss in sensory attributes is expected but stability of the product under different packaging conditions under refrigeration was unknown.

Therefore, present study was aimed to determine the storage stability of standardized meat nuggets with pork and fish flesh at refrigeration (4±1ºC) storage in LDPE pouches upto 28 days. The objective of this study was to evaluate the changes in microbial growth in meat nuggets containing pork and fish flesh.

MATERIALS AND METHODS

Preparation of nuggets

Mincing of pork and fish flesh without bones (obtained from silvary variety – commonly named as Bakar fish) was done through 8 mm sieve plate of a hand operated meat mincer only once followed by beating the mixture of meat and fish flesh by wooden hammer manually several times with salt and refined wheat flour. This emulsion was taken and pre-weighed ingredients such as vegetable oil, salt, spices, condiments, sodium nitrite, sodium tripolyphosphate and liquid egg white were added to it as per Khandagale *et al.* (2012). Then this mixture was blended manually by hand to distribute ingredients evenly. Emulsion was filled tightly in rectangular aluminum moulds and these moulds were steam cooked in a specially designed vessel without pressure for 40 min. in presence of steam.

Microbial quality

Various microbiological parameters includes total plate count, psychrotrophs, coliforms and yeasts and molds counts were determined by following standard methods described by (APHA, 1984). Preparation of samples and serial dilution of nuggets were done near the flame in a horizontal laminar flow unit (Model: CAT. No. YSI-188, Yarco Sales (P) Ltd., New Delhi) which was pre-sterilized by ultraviolet radiation, observing all possible aseptic precautions. About 10 g of

sample was aseptically weighed and transferred to a sterile mortar and homogenized for 2 min using a sterile pestle, while adding 90 ml of 0.1% sterile peptone water to make 10^{-1} dilution. Sterile peptone water (0.1%) was used as diluent for making further diutions. 1 ml of 10^{-1} dilution was mixed with 9 ml of 0.1 % peptone water to obtain a 10^{-2} dilution and so on. Serial dilution was made as per requirement.

Statistical analysis

The data obtained from various trials under each experiment were subjected to statistical analysis (Snedecor and Cochran, 1989) for analysis of variance and Duncan's multiple range test (DMRT) to compare the means. Means and standard error were calculated following the standard statistical procedures. Each experiment was replicated thrice and the samples were analyzed in duplicate. In significant effects, least significant differences were calculated at a appropriate level of significance (0.05) for a pair-wise comparison of treatment means.

RESULTS AND DISCUSSION

Microbiological analysis of nuggets during storage indicated an increasing trend (Table 1). The total plate counts showed an significant ($P<0.01$) increasing trend with the advancement of storage period however, no significant differences were observed in nuggets of control I, control II and in treatment. Similar findings were also reported by (Nath and Mahapatra, 1995). The total plate counts were also within the limit of log 6 cfu/g prescribed for cooked meat products (Shapton and Shapton, 1991) These counts were also comparable with the microbial loads (log 4.25) reported in goat meat products by (Agnihotri and Pal, 2000) and (Das *et al*., 2008).

The psychrotrophs were not detected till 14th day in both controls and treatment andthere after a gradual increase in the psychrotrophic count of control and treatment samples with advancement of refrigerated storage was observed. The absence of psychrotrophic bacteria in initial periods of storage could be due to sufficient lethal heat treatment during cooking. The lower count in psychrotroph may be due to influence of the inhibitory effect of spices, nitrite, WEL etc. The count remained well below the threshold level of acceptability of cooked meat product (Jay, 1996). Cremer and Chipley, (1977) described the permissible level of psychrophilic count as 4.6 $\log_{10}$ cfu/gm in cooked meat and meat products. No coliforms were detected till 14th day of storage in both controls and treatment. Coliform counts increased significantly ($P<0.01$) on 21st day in the treatment but not in control I. Control II had significantly higher ($P<0.01$) coliform count than control I and the treatment. Samples in treatment had significantly higher ($P<0.01$) coliform count than control I. The absence of coliform bacteria during initial periods of storage could be due to destruction during cooking or hygienic practices adopted in preparation of the product (Dawson, 1975; Kumar, 2001).

Yeast and mold counts were not detected till 21st day. On 28th day yeast and mold

Table 1: Microbial quality of meat nuggets under refrigeration (4±1°C) (Mean±SE)*.

Microbial Count (log_{10} cfu/gm)		Storage Days 0	7	14	21	28
Total plateCount	Control I	2.25±0.01^{e}	2.54±0.01^{d}	3.07±0.01^{c}	3.86±0.08^{b}	4.36±0.10a
	Control II	2.52±0.22^{d}	2.51±0.03^{d}	3.11±0.02^{c}	4.00±0.01^{b}	4.35±0.01^{a}
	Treatment	2.25±0.33^{e}	2.56±0.04^{d}	3.10±0.02^{c}	3.97±0.01b	4.44±0.11a
Psychrophillic count	Control I	ND	ND	1.47±0.03^{Bc}	1.82±0.02^{Bb}	2.91±0.01^{Ba}
	Control II	ND	ND	1.24±0.01^{Cc}	2.18±0.03^{Ab}	3.10±0.02^{Aa}
	Treatment	ND	ND	1.52±0.01Ac	1.81±0.04Bb	2.94±0.01Ba
Coliform count	Control I	ND	ND	ND	ND	0.51±0.03^{C}
	Control II	ND	ND	ND	0.56±0.01^{A}	0.56±0.03^{A}
	Treatment	ND	ND	ND	0.51±0.02^{Bb}	0.53±0.01^{Ba}
Yeast and Mold count	Control I	ND	ND	ND	ND	0.87±0.01^{B}
	Control II	ND	ND	ND	ND	0.99±0.02^{A}
	Treatment	ND	ND	ND	ND	0.97±0.01^{A}

*Mean with different superscript (small letter row-wise and capital letter column-wise) differ significantly ($p<0.05$) n=45, Control I: (100% pork+ 0% fish, control II: (0% Pork + 100% Fish), Treatment: 80% pork+ 20% fish, ND- Not detected

counts of the treatment was lower than control II and higher than control I. The absence of yeast and mold up to 21 days of storage could be due to inhibitory effect of antioxidant on growth of yeast and mold or because of their thermal destruction during cooking. Microbiological counts were below the permissible limits for cooked nuggets which indicated that the product was safe for consumption up to 28 days of refrigerated storage (4±1°C).

Thus the study was concluded that the pork nuggets containing fish flesh could be stored safely in LDPE bags, at refrigeration temperature (4±1°C) for 28 days without marked deterioration in microbiological quality.

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