

STORAGE QUALITY AND SHELF LIFE EVALUATION OF VACUUM PACKAGED CHICKEN PATTIES FORTIFIED WITH CALCIUM, ALPHATOCOPHEROL AND ASCORBIC ACID AT REFRIGERATED TEMPERATURE

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ABSTRACT

The present study was carried out to determine the storage quality and shelf life of low fat chicken patties fortified with calcium, alpha tocopherol and ascorbic acid. The patties were prepared as per prior optimized formulation and standardized processing conditions. The low fat fortified designer chicken patties and control i.e. product without fortification were packaged in multilayer nylon pouches and stored at refrigeration (4±1°C) for 42 days. The samples were drawn and analyzed at 14 days interval for pH, thiobarbituric acid (TBA) reacting substances, sensory evaluation and microbiological quality. The study revealed significantly lower (P<0.05) pH, TBA value, total plate count and psychrotropic count in fortified chicken meat patties as compared to control. Both control and fortified patties exhibited a gradual decrease in sensory panel ratings with storage, however, the values were in moderate acceptability range till the end of experiment.

Key words: Storage quality, fortified chicken patties, vacuum storage

With the increase in general awareness about the health and diet related diseases, the consumers are increasingly becoming conscious with respect to food they eat. Excess consumption of salt, saturated fats and calories have proved to be predisposing factors to the incidence of coronary heart diseases, obesity and hypertension (Law *et al.*, 1991; Jimenez-Colmenero *et al.*, 2001). The designer food products, now a days, are in demand by the consumers. Designer foods can be prepared by removing the potentially harmful ingredients like fat or fortifying the desirable ingredients in food which are absent or present in very minute concentrations (Jimenez-Colmenero *et al.*, 2006). Food fortification is one of the relevant modes of action to address the issue of micronutrient malnutrition in developing countries (FAO, 1995). With the care that addition of fortificants at the required levels must not affect the organoleptic quality of the food.

Meat and meat products are being recognised as a good source of many nutrients but a negative campaign against them has led to the development of concept of designer meat products (Mehta *et al.*, 2013). Meat products are usually poor source of calcium, alpha tocopherol and ascorbic acid and thereby fortification with

these along with low fat (<10%) suits to the preparation in demand. The fortified low fat chicken patties are of perishable nature because they are rich in nutrients. The increase in microbial count and loss in sensory attributes is expected but stability of the product under vacuum packaging conditions in refrigeration is largely unknown. Therefore, the present study was taken up to determine the storage stability of vacuum packed designer meat patties at refrigeration temperature up to 42 days.

MATERIALS AND METHODS

Analytical Procedures: Designer low fat chicken patties fortified with calcium, alpha tocopherol and ascorbic acid hereinafter referred to as fortified patties were prepared as per prior optimized formulation and standardized processing conditions. In the fortified patties, calcium lactate (1.75%), alpha tocopherol acetate (0.029%) and ascorbate (0.15%) were found to be optimum (Mehta, 2008). The fortified product and control patties were packaged in multilayer nylon pouches and stored at refrigeration (4±1°C) for 42 days. The samples were analyzed at 14 days interval for pH, thiobarbituric acid reacting substances (TBARS), sensory evaluation and microbiological quality to determine the storage stability.

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Organoleptic Quality: The products were evaluated for general appearance, flavour, juiciness, texture, saltiness and overall acceptability using 8-point descriptive scale (Keeton, 1983), where eight is extremely desirable and one is extremely undesirable. The pH was determined as per Trout *et al.* (1992). For estimation, 10 g sample was mixed/blended with 50 ml distilled water using an Ultra Turrex T25 tissue homogenizer (Model T25, Janke and Kenkel, 1 KA Labor Technik, Germany) for 1 min. The pH of the homogenate was recorded using a digital pH meter (Century, Model: CP-901: Sonar). The method of Tarladgais *et al.* (1960) was followed to estimate TBARS value (expressed as mg malonaldehyde/kg of sample).

Microbiological Evaluation: All the microbiological parameters (total plate count, psychrotrophic count, anaerobic count and coliform count) of the patties were determined as per the methods described by APHA (1984) and the counts were expressed as colony forming units (CFU) per gram.

Statistical Analysis: The data were subjected to statistical analysis (Snedecor and Cochran, 1989) for analysis of variance and Duncan's multiple range test (DMRT) to compare the means.

RESULTS AND DISCUSSION

Physico-chemical Properties: The pH of the fortified patties was significantly lower ($P<0.05$) as compared to control throughout the period of storage (Table 1). An overall decrease in pH of vacuum packaged control and fortified patties during storage might be due to breakdown of carbohydrates into organic acid mainly lactic acid by bacteria (Incze, 1992). A similar reduction in pH values during storage had been reported by Lee *et al.* (1999) Kumar and Sharma (2004), Aksu and Kaya (2005) and Khate (2007).

The control patties had significantly higher TBA value than fortified patties (Table 1). This could probably be due to the presence of alpha tocopherol and ascorbic acid in fortified product which acted as an antioxidant and thereby decreasing the TBA value. A similar trend in TBA value during storage had also been reported by Serdaroglu *et al.* (2004) in chicken patties incorporated with ascorbic acid and tocopherol acetate. Aksu and Kaya (2005) reported a significant decrease in the TBA value of Kavurma (a cooked meat product treated with alpha tocopherol) than control during storage. The TBA value showed a significant increase ($P<0.05$) during storage but remained well below the threshold level of 1.0 (Labuza,

1971) in both the products and any perceivable rancidity was not recorded during storage. An increase in TBA values during storage had also been reported by Suman (2001), Kumar and Sharma (2004) and Khate (2007) in low fat ground buffalo meat patties, low fat ground pork patties and low salt and fat pork sausages, respectively.

Microbiological Properties: Various microbiological parameters (Table 1) showed an increasing trend with an increase in the storage period. Total plate count increased significantly ($P<0.05$) in both control and fortified patties during storage but there was a significantly lower ($P<0.05$) plate count in fortified patties as compared to controls. This might be due to the presence of calcium lactate and ascorbic acid in fortified patties which resulted in lower pH and thereby inhibiting the growth of micro-organisms. Debevere (1989) reported an inhibition of microbes in vacuum packed pork liver pate incorporated with 2% sodium lactate. Tan and Shelef (2002) also reported a reduction in microbial load in refrigerated fresh ground pork treated with lactate. The increase in total plate count in vacuum packaged product is in accordance with Kumar and Sharma (2004) and Khate (2007).

Psychrotrophs were not detected up to 14th day of storage in either of control or fortified patties due to sufficient heat treatment during cooking which drastically injured and killed the psychrotrophs in patties (Jay, 1996). A significant increase ($P<0.05$) was observed on 42nd day of storage, however, it remained within an acceptable limit of 4.6 log cfu/g in cooked meat and meat products as described by Creamer and Chipley (1977).

Anaerobes could be detected only on 28th day of storage in both control and fortified patties, although a significant increase ($P<0.05$) was recorded from 28th to 42nd day in both types of patties. Similar findings have been reported by Kumar and Sharma (2004) and Khate (2007) in pork patties and designer pork sausages, respectively. Coliforms were not detected throughout the storage period in both control and fortified patties due to their destruction owing to high thermal treatment during cooking. Moreover, the vacuum environmental conditions during storage were not favourable to the growth of aerobic coliforms. Similar findings were observed by Kumar and Sharma (2004) in low fat pork patties.

Sensory Quality: A gradual decrease in mean sensory scores of all the attributes in fortified patties as well as control was observed with the advancement of storage period (Table 2). A significant decrease in general

Table 1
Effect of refrigerated storage (4±1°C) on physico-chemical and microbiological qualities of vacuum packaged low fat chicken meat patties fortified with calcium, vitamin E and vitamin C

Parameters	Group	Storage (days)			
		0	14	28	42
pH	Control	6.16±0.01 ^{aA}	6.11±0.012 ^{aA}	5.98±0.013 ^{bA}	5.71±0.014 ^{cA}
	Treatment	5.71±0.01 ^{abB}	5.69±0.012 ^{abB}	5.67±0.01 ^{bb}	5.63±0.013 ^{cb}
Thiobarbituric acid value (mg malonaldehyde/kg)	Control	0.11±0.01 ^{dA}	0.28±0.011 ^{cA}	0.42±0.01 ^{bA}	0.59±0.015 ^{aA}
	Treatment	0.03±0.01 ^{dB}	0.13±0.01 ^{cb}	0.25±0.012 ^{bb}	0.34±0.013 ^{ab}
Total plate count (log ₁₀ cfu/g)	Control	2.23±0.03 ^{dA}	2.97±0.10 ^{cA}	3.90±0.05 ^{bA}	4.86±0.15 ^{aA}
	Treatment	1.96±0.12 ^{cb}	2.10±0.0 ^{cb}	2.49±0.4 ^{bB}	2.97±0.06 ^{ab}
Psychrotrophic count (log ₁₀ cfu/g)	Control	ND	ND	1.63±0.06 ^{bA}	2.25±0.04 ^{aA}
	Treatment	ND	ND	1.51±0.07 ^{bA}	2.13±0.18 ^{aA}
Anaerobic count (log ₁₀ cfu/g)	Control	ND	ND	1.28±0.08 ^{bA}	1.52±0.05 ^{aA}
	Treatment	ND	ND	1.22±0.05 ^{bA}	1.40±0.07 ^{aA}
Coliform count (log ₁₀ cfu/g)	Control	ND	ND	ND	ND
	Treatment	ND	ND	ND	ND

Means bearing different superscripts row wise (small letter) and column wise (capital letter) differ significantly (P<0.05); ND=Not detected; n=6 observations per treatment at each storage period.

appearance score was observed only on 42nd day in case of fortified patties and 28th day of storage in case of control. This could be due to some pigment breakdown and browning reactions as reported by Che Man *et al.* (1995), Suman (2001) and Khate (2007). A significant decrease in flavour score of fortified chicken patties was observed only on 42nd day of storage, whereas in control chicken patties, it was observed on 28th day onwards as compared to day 0 score. The change in flavour could be due to an increase in TBA value (Tarladgis *et al.*, 1960).

Both texture and juiciness scores of the fortified patties were not affected up to 28th day of storage and a significant decrease compared to controls was observed only on 42nd day of storage. The reduction in juiciness score with an increase in storage period had also been reported by Mathew (1992) and Suman (2001) in cured and smoked buffalo meat chunks and low fat ground buffalo meat patties, respectively. The storage did not bring about any significant difference on the saltiness of the control and fortified patties. However, saltiness score of control was

Table 2
Effect of refrigerated storage (4±1°C) on sensory attributes of vacuum packaged low fat chicken patties fortified with calcium, vitamin E and vitamin C

Attributes	Group	Storage (days)			
		0	14	28	42
General appearance	Control	7.11±0.05 ^a	6.99±0.06 ^{ab}	6.86±0.05 ^{bb}	6.68±0.05 ^{cb}
	Treatment	7.13±0.05 ^a	7.08±0.03 ^a	7.01±0.03 ^{abA}	6.89±0.06 ^{bA}
Flavour	Control	7.06±0.06 ^a	6.95±0.04 ^{ab}	6.80±0.06 ^{bc}	6.67±0.08 ^c
	Treatment	6.95±0.06 ^a	6.84±0.05 ^{ab}	6.74±0.03 ^{ab}	6.60±0.04 ^b
Juiciness	Control	7.04±0.06 ^a	6.95±0.05 ^{ab}	6.87±0.07 ^{ab}	6.74±0.06 ^c
	Treatment	6.92±0.08 ^a	6.84±0.06 ^{ab}	6.75±0.07 ^{ab}	6.67±0.05 ^b
Texture	Control	7.04±0.04 ^a	6.97±0.05 ^{ab}	6.89±0.06 ^{ab}	6.80±0.10 ^b
	Treatment	6.95±0.09 ^a	6.87±0.06 ^{ab}	6.81±0.07 ^{ab}	6.71±0.08 ^b
Saltiness	Control	7.08±0.05 ^A	7.01±0.07 ^A	6.95±0.08 ^A	6.91±0.05 ^A
	Treatment	6.91±0.05 ^B	6.88±0.04 ^A	6.82±0.06 ^A	6.75±0.02 ^A
Overall acceptability	Control	7.05±0.08 ^a	6.96±0.05 ^{ab}	6.84±0.06 ^{ab}	6.66±0.08 ^b
	Treatment	6.99±0.08 ^a	6.87±0.03 ^a	6.81±0.07 ^a	6.75±0.09 ^a

Means bearing different superscripts row wise (small letter) and column wise (capital letter) differ significantly (P<0.05); n=21 observations per treatment at each storage period.

significantly higher than fortified patties throughout the storage period due to obvious difference in their formulation. There was no change in overall acceptability scores of fortified patties upto 42nd day of storage. However, a significantly lower overall acceptability score was observed in control patties only on 42nd day of storage. The reduction in overall acceptability scores in both control and fortified patties could be due to some protein degradation and lipid oxidation.

Thus the present study revealed that low fat chicken patties fortified with calcium, alpha tocopherol and ascorbic acid had acceptable physico-chemical, microbiological and sensory attributes during the entire period of refrigerated storage under vacuum packaging upto 42 days. The products consistently maintained sensory quality and acceptability in moderate acceptability range. Microbial counts and rancidity level also remained well below the permissible level for chicken patties. The pH of fortified patties remained comparatively low. The overall acceptability was not affected during the 42 days of refrigerated (4±1°C) storage under vacuum while other sensory attributes were slightly affected on 42nd day of storage.

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