Haryana Vet. (June, 2015) **54 (1)**, 25-28

Research Article

STUDIES ON PHYSICO-CHEMICAL PROPERTIES AND SHELF LIFE OF DEVELOPED CHICKEN MEAT ANALOGUE ROLLS

P. YADAV, S.S. AHLAWAT*, G. JAIRATH, M. RANI and S. BISHNOI
Department of Livestock Products Technology, College of Veterinary Sciences
Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar-125 004, India

Received: 01.10.2014; Accepted: 19.01.2015

ABSTRACT

A study was conducted to evaluate the quality and shelf life of developed chicken meat analogue rolls. The product was prepared from combinations of 25% each of wheat flour, maize flour and textured soy grit (soaked), and mushroom paste as per the standard procedure adopted for control chicken meat rolls (100% chicken meat). Percent fat, protein, ash and moisture content including pH and shear press values of developed meat analogue rolls were lower than that of control, however, percent cooking yield was slightly higher in the developed meat analogue rolls. There were no significant differences in SPC and yeast and mold counts (log cfu/g) between control and developed chicken meat analogue rolls, irrespective of storage period. However, the counts increased significantly with the storage period both in control as well as in developed meat analogue rolls at both the refrigeration (4±2^{0}C) and ambient (27±2°C) temperatures. All the sensory attributes including overall acceptability scores, except colour, of developed meat analogue rolls on 0 day were similar to the control and decreased significantly during storage, irrespective of temperature. Both the samples were highly acceptable upto 12 days of storage at refrigeration temperature and upto 3 days of storage at ambient temperature. It is concluded that the developed chicken meat analogue rolls comparable with control (chicken meat roll) were microbiologically safe and highly acceptable up to 12 days at refrigeration and up to 3 days at ambient temperature of storage.

Key words: Chicken meat analogue rolls, physico-chemical properties, shelf life

Worldwide sale of processed food is more than US $3 trillion and that of packaged food is almost 2 trillion (Mahalik, 2008). As the income has risen in many countries during the past few decades, consumers have begun purchasing more high-value processed food compared to staple food. Food processing is driven by health and hygiene factors and demands for high quality food, fresh taste, balanced nutrients, and food safety (Mahalik, 2008).

Meat is a high quality food but becomes unhealthy due to incorporation of large quantity of saturated fat during processing. Consumption of meat products has been associated with increased risk of cardio-vascular diseases, hypertension, obesity, colorectal cancers etc. (Fernandez-Gines *et al*., 2005). However, number of non-vegetarians is increasing gradually in India, whereas in developed countries the number of vegetarians is increasing rapidly. It has been predicted that majority population of Europe will be vegetarian by 2020 and this trend of increasing vegetarianism would also be noticed in India after some years (Yadav and Kumar, 2006).

A meat analogue is a designed food product that is made to have similar texture, colour, appearance and taste like meat (Soya foods Association of North America, 2010). Vegetarians and other health conscious individuals eat meat analogues because these analogues are relatively high in protein and are versatile to be broiled, baked or roasted. Moreover, there is a shortage of protein with high biological value in developing countries (Reiser *et al*., 2009), and the cost of meat is very high. Plant proteins such as glutens of wheat, peanut, yeast, and soybean are the main source for development of meat analogues (Anon, 1979). These also provide a texture and meat like taste when mixed with other ingredients.

On PDCAAS (Protein Digestibility Corrected Amino Acid Score) scale, soy protein was reported to be equivalent to animal protein with a score of 1.0; the highest possible rating with comparable biological value to that of meat (Hoffman and Falvo, 2004). It is high value in the manufacturing of emulsion-type products because of its power to emulsify, stabilize, texture and hydrate the products. Therefore, numerous food products have been produced from fibrous cereals and vegetable proteins and have been sold as meat extenders or meat analogue. Meat analogues can replace hamburger, steak, chicken, hot dogs, sausage and many other meat products (Hodges and Flynt, 2004). Hence, the study was undertaken for assessment of nutritional, physico-chemical and sensory characteristics and shelf life of developed chicken meat analogue rolls.

*Corresponding author: ahlawatss9@gmail.com

MATERIALS AND METHODS

Chicken meat analogue rolls were prepared from combinations of wheat flour, maize flour, textured soy grit (soaked) and mushroom paste 25% each as per the procedure adopted for preparation of control chicken meat rolls. Control rolls contained minced chicken meat (100%) including additives (condiments 4%, spice mix 2%, table salt 2%, sodium tri-polyphosphate 0.4%, sodium nitrite 100 ppm, soy refined oil 4% and ice flakes 15%) over and above 100%. Batter was prepared in bowl chopper, thoroughly kneaded and hand molded in autoclaveable beakers. The rolls were cooked in a pressure cooker for 30 min at 120+2^{0}C. The cooked rolls were removed from beakers, cooled for 1 h and cut in to 5 mm (thickness) slices. Steam cooked rolls were subjected to physico-chemical, sensory evaluation and shelf life studies. All the ingredients were procured from local market.

Proximate composition was determined by the standard methods of AOAC (2000) and the method of Trout *et al*. (1992) was followed for determining the pH of the samples. Weight of rolls before and after cooking was recorded and cooking loss (%) was calculated. Force needed to shear one cm^3 piece of roll was recorded using Warner Bratzler Shear Press (Salter Model No. 235 6S) and shear press values were expressed in kg/cm^2.

The products were stored at refrigeration (4±2^{0}C) and ambient (27±2^{0}C) temperatures for 15 days and were evaluated at 0, 3, 6, 9, 12 and 15th day for microbiological quality (APHA, 1984). The sensory scores viz., colour, flavor, appearance, tenderness, juiciness and overall acceptability were evaluated using 9-point Hedonic scale by a panel of six semi-trained judges. The experiments were replicated thrice in duplicate and subjected to statistical analysis using completely randomized design as per Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

The results revealed that percent fat content of developed meat analogue rolls was considerably lower than that of chicken meat rolls (Table 1). It is a well known fact that the ingredients (wheat, maize and mushroom) used in the development of meat analogue rolls as raw materials are poor source of fat as compared to chicken meat. Some fat contents of soy grits might be decreased due to soaking during processing as also reported by Bridget and Sanusi (2005).

Percent protein and ash content of chicken meat rolls were significantly (P<0.05) higher than that of developed meat analogue rolls (Table 1). The protein and mineral contents are more in meat, however, the quality of soy and corn proteins have been reported to be better by Hsu *et al*. (1977a, b). These authors selected soy concentrate as one of the blend component because of its high nutritional quality (C-PER 2.5). Corn gluten meal was another selected product as a high protein ingredient. Another reason of low ash content in developed meat analogue rolls might be due to decrease in ash content during soaking of soy grits (Bridget and Sanusi, 2005). Percent moisture content of the developed meat analogue rolls was significantly lower than that of controls (Table 1). Steaming of flours denatured the gluten and reduced the water absorption capacity in the developed analogue rolls. Prakash and Rao (1999) also reported that steaming of wheat flours at atmospheric pressure for 15 min completely denatured the gluten and reduced the water absorption capacity from 58.4% to 45.0%.

The pH and shear press values (kg/cm^2) was slightly lower and percent cooking yield was slightly higher in the developed meat analogue rolls as compared to the chicken meat rolls, however, the differences were not statistically significant.

There were no significant difference in standard plate counts (SPC; log cfu/g) between control and developed meat analogue rolls, irrespective of storage period. However, the counts increased significantly with the increase in storage period both in control as well in developed meat analogue rolls at both the refrigeration (4±2^{0}C) and ambient (27±2^{0}C) storage temperatures (Table 2). The SPC counts in both control and developed meat analogue rolls were within the safety limits (i.e. 5 log cfu/g) up to 12th day at refrigeration and up to 3rd day at ambient storage temperatures (Table 2). Similar

Table 1

Proximate composition and physico-chemical properties of chicken meat rolls and developed meat analogue rolls

Parameter	Chicken meat rolls	Meat analogue rolls
Moisture (%)	64.35^b±0.49	62.45^a±0.54
Protein (%)	19.97^b±0.11	15.79^a±0.13
Fat (%)	11.12^b±0.10	8.20^a±0.16
Ash (%)	4.05^b±0.04	3.75^a±0.04
pH value	6.24^a±0.02	6.21^a±0.01
Shear press value (kg/cm^3)	0.33^a±0.02	0.28^a±0.03
Cooking yield (%)	95.19^a±0.27	95.44^a±0.28

Mean±SD with different superscripts in rows differ significantly (P<0.05). n=6

Table 2

Microbial count (log cfu/g) of control and developed meat analogue rolls at different storage temperatures

Parameter	Days	Refrigeration (4±2^{0}C) temperature		Ambient (27±2^{0}C) temperature	
		Chicken meat roll	Developed meat analogue roll	Chicken meat roll	Developed meat analogue roll
Standard plate count	0	2.93^a±0.01	2.95^a±0.01	2.93^a±0.03	2.95^a±0.02
	3	3.14^b±0.04	3.17^b±0.03	4.04^d±0.06	4.07^d±0.02
	6	3.46^c±0.01	3.48^c±0.02	Visibly spoiled	Visibly spoiled
	9	4.01^d±0.03	4.04^d±0.02	-	-
	12	4.68^e±0.02	4.81^e±0.01	-	-
	15	Visibly spoiled	Visibly spoiled	-	-
Yeast and mould count	0	1.36^a±0.01	1.33^a±0.02	1.75^b±0.02	1.33^a±0.03
	3	1.47^b±0.03	1.44^b±0.02	2.30^d±0.01	2.22^d±0.02
	6	1.78^c±0.03	1.76^c±0.02	N.D.	N.D.
	9	2.27^d±0.01	2.25^d±0.03	N.D.	N.D.
	12	2.42^e±0.02	2.39^e±0.01	N.D.	N.D.
	15	N.D.	N.D.	N.D.	N.D.

Mean±SD with different superscripts for a parameter in a column differ significantly (P<0.05).
N.D.=Not done; n=6

Table 3

Sensory scores of control and developed meat analogue rolls at different storage temperature

Days	Rolls	Sensory scores for					
		Colour	Flavour	Tenderness	Juiciness	Texture	Overall
Refrigeration temperature (4±2^{0}C)							
0	C	8.33^c±0.51	8.66^d±0.51	7.66^c±0.51	8.16^d±0.75	8.33^e±0.51	8.66^c±0.51
	T	7.66^b±0.51	8.16^d±0.75	7.33^c±0.51	8.33^d±0.51	8.33^e±0.51	8.33^c±0.51
3	C	7.66^b±0.51	7.50^{ab}±0.54	7.50^{bc}±0.54	7.66^{bc}±0.52	7.83^b±0.40	7.50^b±0.54
	T	7.50^b±0.54	7.66^b±0.51	7.66^{bc}±0.51	8.00^{cd}±0.63	8.00^{cd}±0.63	7.66^b±0.52
6	C	7.66^b±0.51	7.50^{ab}±0.54	7.50^{bc}±0.54	7.66^{bc}±0.51	7.83^b±0.40	7.50^b±0.54
	T	7.66^b±0.51	7.66^b±0.51	7.33^b±0.52	8.00^{cd}±0.63	8.00^{cd}±0.63	7.50^b±0.55
9	C	7.73^b±0.51	7.50^{ab}±0.54	7.66^{bc}±0.51	7.33^{ab}±0.52	7.50^{ab}±0.54	7.33^{ab}±0.55
	T	7.00^{ab}±0.63	7.66^b±0.51	7.66^{bc}±0.52	7.16^a±0.41	7.66^{abc}±0.52	7.33^{ab}±0.54
12	C	6.50^a±0.54	7.00^a±0.63	6.66^a±0.51	7.33^{ab}±0.51	7.33^a±0.52	7.33^{ab}±0.41
	T	7.00^{ab}±0.63	7.50^{ab}±0.54	7.33^b±0.52	7.16^a±0.40	7.50^{ab}±0.54	7.00^a±0.51
Ambient temperature (27±2ºC)							
0	C	8.33^c±0.51	8.66^d±0.51	7.66^c±0.51	8.16^d±0.75	8.33^e±0.51	8.66^c±0.51
	T	7.66^b±0.51	8.16^d±0.75	7.33^c±0.51	8.33^d±0.51	8.33^e±0.51	8.33^c±0.51
3	C	6.33^a±0.51	6.50^a±0.63	6.83^a±0.41	6.66^a±0.54	5.83^a±0.51	6.50^a±0.41
	T	6.66^a±0.52	6.66^a±0.51	6.50^a±0.54	6.83^{ab}±0.52	5.66^a±0.63	6.33^a±0.63

Mean±SD with different superscripts in a column for a parameter differ significantly (P<0.05).
n=6; C=Chicken meat roll; T=Developed meat analogue roll

trends of observations were also recorded for yeast and mould counts both in control and developed meat analogue rolls and the counts were within the safety limits. These results are in accordance with the findings of Anon (1979) and Anandh and Lakshmanan (2010). However, higher initial microbial load of control and developed analogue rolls was probably due to pre-processing microbial load and environmental conditions that promoted microbial growth during processing (Filho *et al.*, 2005).

All the sensory attributes including overall acceptability scores, except colour, of developed meat analogue rolls on 0 day were statistically similar to the chicken meat rolls (Table 3). The overall acceptability scores of chicken meat and developed meat analogue rolls during storage decreased significantly from 8.66 and 8.33 (at 0 day) to 7.33 and 7.00 (12th day), respectively. However, at the end of storage, the overall acceptability scores of controls were slightly higher than that of developed meat analogue rolls, but the difference was not significant and both the samples were highly acceptable up to 12th day of storage at refrigeration temperature. The trends for all the sensory characteristics score at ambient temperature were similar to the findings recorded at refrigeration storage, but both types of rolls were only

acceptable up to 3rd day of storage. Similar results were also reported by Anandh and Lakshmanan (2010).

From this study, it is concluded that the developed chicken meat analogue rolls were microbiologically safe and acceptable up to 12 days at refrigeration (4±2^{0}C) and up to 3 days at ambient (27±2^{0}C) temperature of storage.

REFERENCES

Anandh A.M. and Lakshmanan, V. (2010). Shelf life of smoked buffalo tripe rolls at refrigeration (4±1^{0}C) temperature. *J. Food Technol*. **8(6)**: 229-233.

Anon. (1979). Soy, binder, flavor combination makes analog preferred by some over real diced meat. *Food Prod. Dev.*. **13(8)**: 42.

AOAC. (2000). Official Methods of Analysis. (17th edn.) Association of Official Analytical Chemists, Gaithersburg, Maryland, USA.

APHA. (1984). Compendium of Method for Microbiological Examination of Food. Speck, M.L. (Edt.) American Public Health Association, Washington DC.

Bridget, O.O. and Sanusi, B.P. (2005). Soaking and cooking of soybean for soy-daddawa production: Bacterial profile and proximate composition. *J. Food Technol*. **3(1)**: 87-91.

Fernandez-Gines, J.M., Fernandez-Lopez, J., Sayas-Barbara, E. and Perez-Alvarez, J.A. (2005). Meat products as functional food: A review. *J. Food Sci*. **70**: R37-R43.

Filho, G.C.S., Vessoni., Penna, T.C. and Schaffner, D.W. (2005). Microbiological quality of vegetable proteins during the preparation of a meat analog. *Italian J. Food Sci.* **17(3)**: 269-283.

Hodges, L.S. and Flynt, C. (2004). Meat Analogs. www.healthline.com/galecontent/ meat-analogs.

Hoffman, J.R. and Falvo, M.J. (2004). Protein-which is best. *J. Sports Sci. Med*. **3**: 118-130.

Hsu, H.W., Satterlee, L.D. and Kendrick, J.G. (1977a). Computer blending predetermines properties of protein foods. Part I. Experimental design. *Food Prod. Dev*. **1(7)**: 52.

Hsu, H.W., Satterlee, L.D. and Kendrick, J.G. (1977b). Computer blending predetermines properties of protein foods. Part II. Result and discussion. *Food Prod. Dev.* **11(8)**: 70.

Mahalik, N.P. (2008). Survey on Food Processing and packaging technology. Mini Symposium on Industrial Technology Links, Sponsored by Advance Technology Enterprises, California State University, Fresno, USA, March 13.

Prakash, M. and Rao, P.H. (1999) Effect of steaming on the rheological characteristics of wheat flour dough. *Europian Food Res. Technol*. **209**: 122-125.

Reiser, R., Gumudavelli, V., Gharibian, W., James, L. and Yonemoto, L.H. (2009). Meat analog product. United States Patent No: 426104.

Snedecor, G.W. and Cochran, W.G. (1989). Statistical Methods. (8th edn.). Iowa State University Press, Ames, Iowa.

Soya Foods Association of North America. (2010). http:// www.soyfoods.org/soy-products/sales-and-trends.

Trout, E.S., Hunt, M.C., Johnson, D.E., Clans, J.R., Castner, C.L. and Kropf, D.H. (1992). Characteristics of low fat ground beef, containing texture modifying ingredients. *J. Food Sci*. **57**: 19-24.

Yadav, Y. and Kumar, S. (2006). National Survey on The Food Habits of Indian People. In: The Hindu, dated 14th August, 2006. pp1.