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Home Science

EFFECT OF WHEY PROTEIN COATING ON EXTENDING THE SHELF LIFE OF CHICKEN MEAT

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ABSTRACT Applications of natural products with both antioxidants and antimicrobial additives in meat products may be useful to prolong the shelf life of meat. Therefore, minimizing lipid oxidation and delaying or inhibiting product contamination, growth of spoilage and pathogenic organisms in the product are major keys for improving fresh meat shelf life and increasing consumer safety. This article is focused on techniques intended to predict the shelf life of meat and analysing the technological and sensor qualities from measurements carried out on fresh intact meat.

KEYWORDS :

Introduction

Antimicrobial packaging is a promising form of active food packaging, in particular for meat products. Since microbial contamination of these foods occurs primarily at the surface, due to post-processing handling, attempts have been made to improve safety and to delay spoilage by use of antibacterial sprays or dips. However, direct surface application of antibacterial substances onto foods have limited benefits because the active substances are neutralized on contact or diffuse rapidly from the surface into the food mass. On the other hand, incorporation of bactericidal or bacteriostatic agents into meat formulations may result in partial inactivation of the active substances by product constituents and is therefore expected to have only limited effect on the surface microflora (Stefania Quintavalla,*et.al.,* 2002).

Edible coatings, which enhance many desirable physical, chemical, and sensorial properties of food, have been widely used in food processing in recent years. These products play a major role in consumer's diets worldwide (Salvador *et.al.,* 2008). Moisture loss during storage of fresh or frozen meats leads to texture, flavour, and colour changes, while also reducing saleable weight. Edible coatings with good moisture barrier properties could help alleviate the problem of moisture loss. For example, when meat is removed from vacuum packages, a 3–5 percent reduction in weight occurs due to moisture evaporation. Application of coatings prior to vacuum packaging could prevent this moisture loss, thereby having an important economic impact by increasing saleable weight of products (Muhammad Issa Khan *et.al.,* 2013). Edible films and coatings offer some advantages such as edibility, biocompatibility, and aesthetic appearance, barrier properties, being non-toxic, non-polluting and having low cost (Han, 2000).

Frozen storage of meat is an effective means of preservation which prevents or decreases undesirable chemical changes while maintaining many characteristics of fresh meat. However, during long-term storage, meat and meat products may still deteriorate at a much reduced rate. Edible, protective film coatings can lessen or prevent quality changes and prolong storage life in foods such as frozen meat by acting as barriers to control moisture transfer, oxygen uptake and loss of volatile aromas and flavours. Such coatings must have appropriate mechanical and sensory properties. Edible films can be made from proteins, polysaccharides, lipids or a combination of these materials as either bilayers or emulsions (Guilbert, 1986; Krochta, 1992).

Films from whey protein isolate (WPI) have been shown to be excellent oxygen barriers (McHugh and Krochta, 1994). Milk protein based edible films are excellent oxygen, lipid, and aroma barriers; however, due to their hydrophilic nature, they have poor moisture barrier properties (Miller and Krochta, 1997; Chick and Ustunol, 1998). Several studies (Kulp and Loewe, 1990; Williams and Mittal, 1999) have shown that edible coatings made of protein, polysaccharide, and oil-containing materials help to prolong the shelf life and preserve the attributes of edible quality (Kilincceker *et. al.,* 2009).

Whey protein is extracted from whey, the liquid material created as a by-product of cheese production .Worldwide whey processing represents a challenge to food technologist to find interesting ways for its utilization. The most successful way to redeem whey solids is considered to be the production of Whey protein concentrate by the application of ultrafiltration (UF) system (Cheryan and Kuo, 1984; Marshall and Harper, 1988). The terminology whey protein concentrate is being used for the dried whey having more than 25 percent protein and as such there is a wide variation in composition of resultant whey protein concentrate, ranging from 25 to 90 percent protein (Renner and Abd El-Salam, 1991). Yetmin *et.al.,* (2001) assert emulsion stability rate was significantly ($p<0.05$) increased by addition of the liquid whey to the formulation, a slight increase in ash content and pH value. When preheated whey protein was used in poultry raw and cooked meat batter results in higher water holding capacity and improves the rheological properties and reduces cooking loss (Hongsprabhas and Barbut, 1999).

Materials and Methods

The study was carried out at Indian Institute of Crop Processing Technology, Ministry of Food Processing Industries, (Government of India), Thanjavur. Details of techniques followed, materials used, test and design procedures adopted *etc.,* are discussed.

The chicken meats required for the present study were procured from the local market of Thanjavur. The skin of the meat has been removed. Special care was taken during the transportation of meat so as to prevent the spoilage. The selected chicken meat samples were washed with portable water to remove any extraneous matter adhering on the meat and the samples were taken for further processing.

The packaging material selected for the present study was Low Density Polyethylene (LDPE) which is more heat stable than other polymers. LDPE packaging material of different gauges viz., 50, 62.5 and 80 µm (200, 250 and 300 gauge) were used for packaging of chicken meat under different environmental conditions.

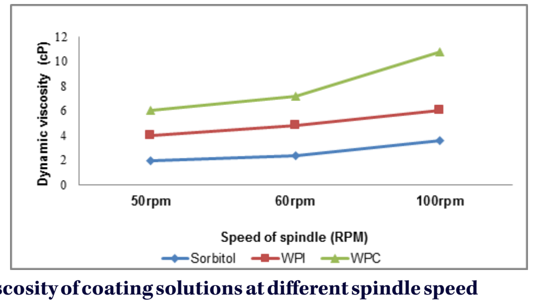
For the present study, whey protein isolate (WPI) and whey protein concentrate (WPC) with sorbitol were used as antimicrobial coating solutions. Two coatings materials of different compositions were prepared: Whey protein concentrate with sorbitol; Whey protein isolate with sorbitol. The edible coatings of whey proteins concentrate and whey protein isolate were applied to meat samples by dipping coating solutions for two minutes. After application of coating solution, these meat samples were dried at room temperature for 15 min to maintain uniform thickness (1.5 mm) of coatings. Non-coated and whey protein concentrate and whey protein isolate coated samples were stored at −18 °C and were subjected of analysis at regular intervals (0, 7, 14, 28 days of storage). The meat samples were analyzed for pH, colour, water activity, texture, meat swelling capacity, fat, protein, and moisture, microbial load before and after storage.

RESULTS AND DISCUSSION

The effect of different coating materials such as whey protein isolate (WPI) and Whey protein concentrate (WPC) on quality parameters of fresh vacuum packed chicken stored at different temperature during the storage periods were analyzed.

It is observed that the coating retention was not significant with different packaging materials studied. The drip loss was found high in chicken packed in 50µm thickness. It is evident from results that weight gain did not differ significantly for different whey proteins concentrate coating indicating the uniformity of coating application for all coating types. These findings are in agreement with the previous work of Diaz *et.al.,* (2011) observed non significant difference in weight gain of whey protein based edible coated Atlantic salmon (*Salmo salar*).

The colour values (L*, a*, b*) indicates the brightness of coating materials. Among the coating materials Whey protein concentrate (WPC) has higher L* value (83.74) than sorbitol and Whey protein isolate (WPI).



Viscosity of coating solutions at different spindle speed

Among the different treatments studied in WPI coating, the hardness was found low in chicken packed in 50µm film and stored at -24 °C. The hardness of chicken packed in 50µm, 62.5 and 80 µm LDPE film on 28th days of storage at -18°C and -24°C were 0.41 and 0.43; 0.41 and 0.47; 0.42 and 0.48 kgf respectively. It is seen that the change in meat swelling capacity in chicken meat due to LDPE thickness (t), storage temperature (T) and storage period (S) was significant at 5 per cent level. Among the different temperatures, the meat swelling capacity values found high in 4°C stored chicken meat compared with -18°C and -24°C. Among the thickness of packaging materials used and storage period studied, the effect of 50 µm, 62.5µm and 80µm have significant effect on meat swelling capacity of chicken meat. Considering the interaction between storage period, thickness of packaging materials and temperature on meat swelling capacity was statistically P<0.05 per cent significant.

Considering the temperature, the chicken stored at -24°C has higher fat value followed by -18°C and 4°C. The WPI and WPC coated vacuum packed chicken stored at 4°C has shelf life of 28 days and the fat content values for WPI coated chicken packed in 50, 62.5 and 80 µm LDPE were found as 0.84, 0.67 and 0.77 per cent respectively. Similarly, the fat content values for WPC coated chicken packed in 50, 62.5 and 80 µm LDPE were found as 0.57, 0.70 and 0.68 per cent respectively. The initial fat content of chicken meat was found as 1.36 per cent.

Meltem, 2006 explained that whey protein did not affect fat contents of the raw and cooked meat balls. Similar results found by Serdaroğlu, M. & Özsümer, M.S. 2003, this study revealed that incorporation of whey powder did not affect the fat content of cooked beef sausage. But the present study concluded that addition of whey protein powder in emulsion sausages caused a slight decrease of fat content of sausage samples.

Milk proteins are good moisture binder when used in meat processing, although they are a lower emulsifying capacity on a soluble protein basis (Mittal and Usborn, 1985; Zorba *et.al.*, 1995). Among the packaging materials 80µm thickness has higher barrier for moisture evaporation during storage than 62.5 and 50µm. Considering the interaction between storage period, thickness of packaging materials and temperature on moisture content was statistically significant (P<0.001) at one per cent level.

The ash content of chicken packed in 50µm, 62.5 and 80 µm LDPE film on 28th days of storage at -18°C and -24°C were 1.56 and 1.68 ; 1.68 and 1.77 ; 1.89 and 1.69 per cent respectively. Similarly, ash content of WPC coated chicken packed in 50µm, 62.5 and 80 µm LDPE film on 28th days of storage at -18°C and -24°C were 1.91 and 1.69 ; 1.86 and 1.83; 1.80 and 1.62 per cent respectively. Considering the coating materials the WPC coated material has retained the ash content than WPI coated chicken during the storage periods.

SUMMARY AND CONCLUSION

Meat can only be stored for future use through proper processing, packaging and storage. Though at present, processing of meat is very little in India, but rapid urbanization and changing life style demand ready to eat and convenient meat products.

Considering the coating materials, the chicken coated with whey protein isolate (WPI) has found best in uniform coating and the drip loss was found less then compared with whey protein concentrate (WPC) coated and control samples. Low temperatures storage has increased the shelf life of meat. Among the different storage temperatures studied (4°C,-18°C and -24°C), the meat stored at -24°C has maintained the tenderness of meat till the end of the storage period. A markedly higher pH value has found for meat samples stored at 4°C compared to those stored at -18 (5.98) and -24°C (5.15) packed at 50µm thickness. The pH of coated chicken remained comparatively low. The chicken packed in LDPE bag at 80µm thickness has maintained the pH during the storage periods.

It is evident from the results that whey protein coating significantly affect the color L*, a* and b* values of meat samples. The storage period of edible coated meat samples also significantly increase the L*, a* and b*value meat samples. Among the different treatments studied in WPI coating, the protein loss was found high in chicken packed in 50µm film and stored at -24 °C. The WPI and WPC coated vacuum packed chicken stored at 4°C has shelf life of 28 days and the Total Platelet Count (TPC) for WPI coated chicken packed in 50, 62.5 and 80 µm LDPE were found as 19x 10^5, 3x 10^5 and 14x 10^5 respectively.

The sensory analysis was done for whey protein isolate (WPI) and whey protein concentrate (WPC) and vacuum packaged chicken during the storage period. Among the treatment the chicken coated in whey protein isolate (WPI) packed in 80µm and stored at -24° C has high score value than the other treatments.

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