Effect of Rosemary (Rosmarinus officinalis L.) Leaves Extract on Quality Attributes of Chicken Powder Incorporated Fried Chicken Snacks

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ABSTRACT

The present study was conducted to develop chicken meat powder (CMP) incorporated ready-to-eat shelf stable fried chicken snacks and evaluate the effect of rosemary leaves extract (RE) incorporation on physico-chemical, microbiological and sensory properties in developed product during ambient storage up to 60 days. Two different groups were made; control (without RE) and second group with RE treated (3% level). In physico-chemical properties, results showed that RE incorporation had highly significant (p<0.01) effect on thiobarbituric acid reactive substances (TBARs), free fatty acid (FFA) and tyrosine value. Similarly in microbiological parameter RE treated product had significantly (p<0.05) lower total plate count (TPC), Staphylococcus count (SC) and significantly (p<0.01) lower yeast and mold count than control. RE incorporation had highly significant effect (p<0.01) on sensory score (texture, flavour and overall acceptability except appearance) of the product during storage period. Therefore, it is concluded that RE incorporation into fried chicken snacks improved physico-chemical (TBARs, free fatty acid content and Tyrosine value), microbiological (Total plate count, Staphylococcus count and yeast and mold count) and sensory parameter (flavor, texture and overall acceptability) of the chicken snacks during 60 days storage.

Keywords: Chicken snacks, microbiological, physico-chemical, rosemary extract and sensory properties

Indian cooking and lifestyle have undergone tremendous changes in the last decades. In the newly rising era of fast and convenience foods, ready-to-eat foods are extensively admired. In Indian perspective, culture, traditions, customs, and taboos determine meat consumption to an immense level particularly in the rural societies (Devi et al., 2014). High mutton price, limited accessibility of fish outside coastal regions and relatively low cost in comparison to other meat, all these helped to make poultry meat the preferred and most consumed meat in India.

Perishability of meat products has been considered as a very serious dilemma, particularly in tropical countries like India, where household refrigeration facility is sparse (Kumar et al., 2015). In this epoch, the energy demand for food preservation and improving the safety of preserved foods vis-à-vis convenience, development of shelf stable products is extremely preferable. There are lots of reports on the development of shelf stable intermediate moisture (IM) products (Kanatt, 2006). Preparation of chicken meat powder is an efficient way to cope up with the problem of perishability. Different meat product could be made by utilization of chicken meat powder in the preparation of chicken powder incorporated an Idli mix to improve the nutritional quality of the products (Bishnoi et al., 2015).

Usually cereal snacks deficient in essential amino acids such as threonine, lysine and tryptophan (Jean et al., 1996), but incorporation of animal protein such as fish, how to cite this article: Saini, A.; Pandey, A.; Sharma, S.; Ambedkar, Y.R.; Suradkar, U.S.; Meena, P.; Raman R. and Gurjar, A.S. (2019). Effect of rosemary (Rosmarinus officinalis L.) leaves extract on quality attributes of chicken powder incorporated fried chicken snacks J. Anim. Res., 9(4): 01-07.
pork, beef, chicken etc, significantly enhances its nutritive value especially with respect to amino acids, flavour and taste (Singh et al., 2015). In the food matrix, meat based snack foods are convenient, easy to carry, highly crispy, attractive, nutritionally sound, shelf-stable (Singh et al., 2013). A verity of meat snacks exist in global market such as Jerky, Popped pork rind, Kilishi, Meat biscuit, Meat cookies, Meat noodles, Meat chips and Meat stick. Likewise chicken snacks are the deep fried, gram floor based, chicken meat powder incorporated shelf stable ready-to-eat meat product.

The most common form of deterioration in dry meat products is oxidative rancidity; which leads to extensive flavor changes, structural damage to proteins leading to loss of freshness that discourages repeat purchases by consumers. The most effective approach to avoid oxidative deterioration of meat products is to integrate antioxidants into formulations. Antioxidants either synthetic or natural have become an indispensable group of food additives mainly because of their distinctive properties of enhancing the shelf-life of food products without any harm to sensory or nutritional qualities (Nanditha and Prabhasankar, 2008). In industrial processing, mainly synthetic antioxidants such as butylated hydroxylanisole (BHA) and butylated hydroxytoluene (BHT) are used to prolong the storage stability of meat products. However, increasing concerns over the safety of synthetic food additives have resulted in a trend toward natural antioxidants.

Natural antioxidants extracted from herbs and spices demonstrate a variety of efficacy when used in different food applications (Bowser et al., 2014). Now a day’s plants are the liberal source to provide man with valuable bioactive substances (Tayel and El-Tras, 2012) and thus different plant products are being evaluated as natural antioxidants to protect and enhance the overall quality of meat and meat products. These natural antioxidants from plants, in the form of extracts, have been obtained from different sources and investigated to decrease the lipid oxidation (Huang et al., 2011; Wojcialet et al., 2011; Das et al., 2012) thus provide a good alternative to synthetic antioxidants. Among natural antioxidant sources, rosemary (Rosmarinus officinalis L.) is highly potent, shrubby herb, with a unique aromatic odour. Antioxidant activity in rosemary is may be due to its high phenolic compounds, such as carnosic acid, rosmarinic acid, carnosol, rosmanol, rosmaquinone and rosmaridiphenol (Riznar et al., 2006).

There is ample amount of information existing on the utilization of rosemary extract as dietary antioxidants in different food and feed formulation as well as in different meat products like chicken frankfurters (Rinzaret et al., 2006), fermented lamb meat sausage (Bowser et al., 2014), chicken nuggets (Teruel et al., 2015), lamb patties (Baker et al., 2013), turkey sausage (Jridi et al., 2015), beef burger (Georgantelis et al., 2007), pork sausage (Sebranek et al., 2005) and chicken meat patties (Al-Hijazeen and Al-Rawashdeh, 2019). However, use of rosemary extract in shelf stable meat products is very scanty. Therefore, the present study has been undertaken develop ready-to-eat shelf stable ready to eat meat product and to explore the effect of rosemary leaves extract in chicken meat powder incorporated self stable ready to eat fried chicken snacks.

MATERIAL AND METHODS

Extract preparation

The rosemary leaves were oven dried at 50°C for 12 hrs followed by grinding and sieving. Pre-weighed powdered leaves were extracted with 70% Ethanol for 24 hrs at 40°C. The extract was collected and concentrated under reduced pressure in a rotary vacuum evaporator (Labconco Corporation, USA) until semi solid consistency. The semisolid mass was oven dried at 50°C at overnight to obtain dried extract. The extract were reconstituted with the same solvent as used for extraction to obtain 5% solutions and stored at 4°C.

Formulation of fried chicken snacks

Chicken meat powder (CMP) was prepared by mincing of spent hen meat in meat mincer (Nova Pvt. Ltd.). Minced meat was pressure cooking for 15 min and air dried at 80°C for 9 hrs and pulverized in mixer (Maharaja White line, India). The dough was prepared by mixing gram flour, spice mix, table salt and rosemary extract (RE) was mixed with CMP. Subsequently, chicken broth was added in to mix to make dough at approx. 40 percent of the formulation and kept it for 10-15 min for conditioning. Later on, the dough was filled in the vermicelli maker machine for preparations of product. Afterward deep fried at 190°C temperature for 45 sec. for fried chicken snacks preparation. RE incorporation could not produce
any significant effect in sensory properties of the product, therefore products with highest (3%) level of RE was selected for further analysis. For the storage study RE treated as well as control sample of fried chicken snacks stored at ambient temperature in Aluminium/Polyethylene laminates bag for physicochemical, microbiological and sensory evaluation up to 60 days in each 15 days interval.

**Analytical methods**

Sample from both groups was taken in triplicate for physiochemical, microbiological and sensory analysis.

**Physico-chemical analysis**

The thiobarbituric acid reactive substances (TBARs), free fatty acid (FFA) content and tyrosine value of value of CMP incorporated fried chicken snacks was analyzed by the method of Witte et al. (1970), Koniecko (1979) and Strange et al. (1977), respectively.

**Microbiological analysis**

Total plate count (TPC), Staphylococcus count (SC), coliform count and yeast and mold count in the samples were determined following the methods described by APHA (1984).

**Sensory analysis**

The sensory properties (appearance, texture, flavor and overall acceptability) of both control and RE treated product stored at ambient temperature were carried out by 9 point hedonic scale to the method of Wichchukita and O’Mahonyc, (2014) by panelists consisting of faculty member and postgraduate students of the department at each 15 days interval up to 60 days.

**STATISTICAL ANALYSIS**

The experiments were replicated thrice and obtained data were analyzed using Statistical Software Packages (SPSS 16.0) following the procedure of Snedecor and Cochrar (1994). P-value less than 0.05 at 5% level and 0.01 at 1% of significance were considered as statistically significant and highly significant respectively. The data were subjected to analysis of variance by ANOVA during storage study.

**RESULT AND DISCUSSION**

**Physico-chemical parameter**

The mean values of physico-chemical parameter of control and treatment groups are presented in Table 1. RE incorporation significantly (p<0.01) reduced the TBARs number of RE treated product as compare to control during entire storage period. The increase in TBARs value was very diminishing RE treated product and remained lowest (0.73 mg malonaldehyde (MDA) kg^{-1} sample).

| Parameters                | Physico-chemical | Storage period (days) |  |  |  |  |
|---------------------------|------------------|-----------------------|  |  |  |  |
|                           |                  | 0                     | 15 | 30 | 45 | 60 |
| TBARs value (mg malonaldehyde/kg) |                  |                       |  |  |  |  |
| C                         | 0.26±0.17^A      | 0.46±0.13^A           | 0.55±0.32^A       | 0.75±0.05^A       | 0.82±0.02^A       |
| RE treated                | 0.25±0.17^A      | 0.38±0.07^B           | 0.50±0.16^B       | 0.68±0.09^B       | 0.73±0.09^B       |
| Tyrosine value (mg/100g of sample) |                  |                       |  |  |  |  |
| C                         | 2.11±0.04^A      | 3.61±0.04^A           | 5.29±0.04^A       | 6.66±0.03^B       | 7.65±0.08^A       |
| RE treated                | 1.98±0.02^A      | 3.11±0.06^B           | 4.52±0.03^B       | 5.83±0.04^B       | 7.03±0.03^B       |
| Free fatty acid value (% of oleic acid) |                  |                       |  |  |  |  |
| C                         | 0.14±0.09^A      | 0.22±0.05^C           | 0.25±0.02^MA      | 0.29±0.07^B       | 0.31±0.01^A       |
| RE treated                | 0.14±0.05^A      | 0.19±0.06^B           | 0.22±0.05^B       | 0.26±0.03^B       | 0.27±0.05^B       |

Mean ±S.E. with different superscripts within each column (capital letters) and each row (small letters) differed highly significantly (p<0.01), significantly (p<0.05) C=control, RE=rosemary leaves extract treated sample; n = 6 for each group.
at 60 days as compared with control (0.82 mg MDA kg\(^{-1}\) sample). Rosemary extract had phenolic antioxidants which react with lipid or hydroxyl radicals and converted them into stable products (Trindade et al., 2007). This result was similar with the study of Baker et al. (2013) and Al-Hijazeen and Al-Rawashdeh, (2019) in karadi lamb patties and chicken meat patties, respectively treated with rosemary extract. Sebranek et al. (2005) reported that 1000 mg/kg of RE was effective as BHA/BHT on TBARS values using precooked-frozen sausage. However, during the storage period, consistence increase in TBA value of both groups were observed. This might be due to auto-oxidation of lipids over a period time and increased microbial population. Similar results have been found by other workers (Modi et al., 2004; Talukder et al., 2016) in chicken nuggets and mutton snack respectively.

Rosemary extract has highly significant (p<0.01) effect on FFA of the product. The initial FFA value was found to be 0.14 (oleic acid %) for both groups, but at the end of storage period (Table 1) RE treated sample (0.27) has significantly lower FFA value than the control (0.31). A similar significant observation was founded by Kenar et al. (2010) and Ucak et al. (2011) in mackerel fish burgers and sardine fillets, respectively. Guran et al. (2015) also reported similar result in fish patties treated with rosemary extract. Although during the storage period consistent increase in FFA value of product in both groups was observed. However RE treated group has diminish increase pattern as compared to control. It may be due to the natural antioxidants prevent lipid oxidation (Indumathi and Reddy, 2015). The Findings were in accordance with Kashyap et al. (2012) in chicken meat patties incorporated with natural antioxidants. Similarly Indumathi and Reddy (2015) reported lower FFA value as control in chicken meat nuggets treated with green tea, guava leaves and curry leaves during storage. Increase in FFA value with storage time was observed by Modi et al. (2007) and Idowu et al. (2010) in kebab mix and kilishi, respectively.

Results of the study revealed that RE has highly significant (p<0.01) effect on tyrosine value of the product. Initially tyrosine value of both groups was 2.11 and 1.98 mg/100g and reached up to 7.65 and 7.03 mg/100g of sample respectively for control and RE treated group respectively (Table 1). Increase in tyrosine value during storage period might be due to increase in microbial load and enhance production of proteolytic enzymes in the late logarithmic phase of microbial growth causing autolysis (Thomas et al., 2010). In the entire storage period RE treated group has significantly lower tyrosine value than the C. The lower values of treated sample attributed due to the antioxidant activity of RE. Similar result was observed by Khare et al. (2016) in chicken cut-up parts treated with natural antioxidants.

**Microbiological analysis**

Microbiological attributes of the control and RE treated product are presented in Table 2. Results of the study indicated

### Table 2: Effect of RE incorporation on the microbiological parameters of fried chicken snacks

| Parameters                  | Storage period (days) |
|-----------------------------|-----------------------|
|                             | 0         | 15        | 30        | 45        | 60        |
| **Microbiological**         |           |           |           |           |           |
| Total plate count (log\(_{10}\) cfu/g) |           |           |           |           |           |
| C                           | 2.24±0.23\(^a\)       | 2.47±0.06\(^a\)       | 2.83±0.11\(^a\)       | 3.04±0.21\(^b\)       | 3.74±0.17\(^a\)       |
| RE treated                  | 2.24±0.02\(^a\)       | 2.34±0.18\(^b\)       | 2.56±0.13\(^b\)       | 2.83±0.06\(^b\)       | 3.13±0.02\(^a\)       |
| Staphylococcus count (log\(_{10}\) cfu/g) |           |           |           |           |           |
| C                           | 1.55±0.07\(^a\)       | 1.78±0.18\(^a\)       | 2.01±0.04\(^a\)       | 2.27±0.05\(^a\)       | 2.51±0.20\(^a\)       |
| RE treated                  | 1.53±0.03\(^a\)       | 1.68±0.03\(^b\)       | 1.84±0.02\(^b\)       | 2.10±0.04\(^b\)       | 2.33±0.07\(^b\)       |
| Coliform count (log\(_{10}\) cfu/g) |           |           |           |           |           |
| C                           | ND        | ND        | ND        | ND        | ND        |
| RE treated                  | ND        | ND        | ND        | ND        | ND        |
| Yeast and mold count (log\(_{10}\) cfu/g) |           |           |           |           |           |
| C                           | ND        | ND        | 1.45±0.05\(^a\)       | 1.88±0.14\(^b\)       | 2.07±0.03\(^a\)       |
| RE treated                  | ND        | ND        | 1.34±0.03\(^a\)       | 1.72±0.01\(^b\)       | 1.83±0.01\(a\)       |

Mean ±S.E. with different superscripts within each column (capital letters) and each row (small letters) differed highly significantly (p<0.01), significantly (p<0.05). C=control, RE=rosemary leaves extract treated sample and ND= not detected; n = 6 for each group.
that RE has significant (p<0.05) effect over TPC and SC of the products in entire storage period. Initial TPC of the product was estimated 2.24 log cfu g⁻¹ for both groups and it reached up to 3.74 and 3.13 log cfu g⁻¹ at the end of the study for C and RE treated product respectively. Rinzar et al. (2006) reported similar findings in chicken frankfurters. Similarly the initial SC of the product was observed 1.55 log cfu g⁻¹ for both groups and reached up to 2.51, 2.33 log cfu g⁻¹ for C and RE treated product respectively at the end of storage period. Although TPC and SC increased along with storage period but increment was slower RE treated product as compare to C. Antimicrobial activity of rosemary might be due to carnosic acid, which is a major bioactive compound of the rosemary extract (Tavassoli and Djomeh, 2011). Coliform could not be founded in both groups during storage period; it might be due to absence of post processing contamination during handling of the product. Yeast and molds were not detected on day 0 and 15 in both groups, but they appeared on the 30th day of storage in both C and RE treated product. RE incorporation has significant (p<0.01) effect on the Yeast and mold count of the product. At the end of storage period RE treated product (1.83) has significantly lower yeast and mold than the C (2.07) log cfu g⁻¹ of sample (Table 2). Similar results reported by Singburaudom (2015) in plant pathogenic fungi. Diminish yeast and mold count in RE treated product might be due to high phenolic content of the rosemary extract (Moghtader et al., 2011).

Sensory evaluation

Data relating to various sensory attributes of control and RE treated product are presented in Table 3. In sensory parameter expect appearance, RE incorporation has significant (p<0.01) effect on flavour, texture and overall acceptability score of the product. Although in both groups consistent decrease in sensory score were observed, but RE treated product found comparatively higher sensory score than the control. The flavour score of RE treated group at 60th day (6.08) was higher than 45th day of control (5.98). The decrease in overall acceptability during storage is due to increase in lipid oxidation and degradation of proteins. The decline in overall acceptability scores indirectly influenced over the scores of flavor, appearance, texture and other sensory attributes (Singh et al., 2011). The progressive decrease in sensory scores could be correlated with an increase succeeding storage days, which favour oxidative rancidity, thereby

Table 3: Effect of RE incorporation on the sensory parameters of fried chicken snacks

| Parameters          | Sensory | Storage period (days) |             |             |             |             |
|---------------------|---------|-----------------------|-------------|-------------|-------------|-------------|
|                     |         | 0         | 15         | 30         | 45         | 60         |
| Appearance          |         | C        | RE treated | C        | RE treated | C        | RE treated |
|                     | 7.71±0.04bA | 7.64±0.02A | 7.55±0.02A | 7.43±0.20bA | 7.26±0.01bA |
| Texture             |         | C        | RE treated | C        | RE treated | C        | RE treated |
|                     | 7.74±0.01bA | 7.65±0.02bA | 7.56±0.01bA | 7.50±0.02bA | 7.41±0.02bA |
| Flavor              |         | C        | RE treated | C        | RE treated | C        | RE treated |
|                     | 7.82±0.01cA | 7.17±0.02cA | 6.35±0.03cA | 5.98±0.07cA | 5.39±0.06cA |
| Overall acceptability |         | C        | RE treated | C        | RE treated | C        | RE treated |
|                     | 7.79±0.06cA | 7.37±0.04cA | 6.28±0.04cA | 6.22±0.06cA | 5.73±0.07cA |

Mean ± S.E. with different superscripts within each column (capital letters) and each row (small letters) differed highly significantly (p<0.01), significantly (p<0.05) C=control, RE=rosemary leaves extract treated sample; n = 21 for each group.
increasing the physico-chemical and microbiological parameter leads to a decrease in sensory scores. Mishra et al. (2015) also reported similar results in meat ring. In general RE treated product was highly favored by panelist because of their desirable sensory score (flavor, texture and overall acceptability).

CONCLUSION

From this study it can be concluded that a ready-to-eat shelf stable meat product can be made by chicken meat powder incorporation in the gram flour. Rosemary leaves extract incorporation improved physico-chemical (TBARs, Free fatty acid content and Tyrosine value), microbiological (Total plate count, Staphylococcus count and yeast and mold count) and sensory score (flavor, texture and overall acceptability) of the fried chicken snacks.

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