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Quality examination of chicken meat products marketed in Quetta, Pakistan

Babar Khan[1], Syed Zulfiqar Ali[2], Sikander Shahzad[3], Muhammad Basharat[4], Jaffar Ali[5*], Amjad Ali[6] and Shagufta Fahmid[7]

[1]Department of Food Technology, Balochistan Agriculture College, Quetta, Pakistan
[2]Department of Plant Pathology, Balochistan Agriculture College, Quetta, Pakistan
[3]Department of Computer Science, Balochistan Agriculture College, Quetta, Pakistan
[4]Office of Agriculture Extension (Plant Protection), Jaffarabad, Balochistan, Pakistan
[5]Office of Agriculture Extension (Plant Protection), Barkhan, Balochistan, Pakistan
[6]Department of Agricultural Extension, Balochistan Agriculture College, Quetta, Pakistan
[7]Department of Chemistry, Sardar Bahadur Khan Women's University, Quetta, Pakistan
*Corresponding author: *jaffaraj2010@yahoo.com*

Abstract

Samples of chicken meat products (burgers, nuggets, kababs, fillets and meatballs) were collected from different food shops in Quetta for quality assessment on the basis of pH, Water Holding Capacity (WHC), moisture, ash, fat, protein contents, Total Volatile Bases (TVB), and Coliform Count (CC) using standard methods in the laboratory of Institute of Food Sciences & Technology, Sindh Agriculture University (SAU) Tandojam, Pakistan. The pH was higher for meatballs (6.10) than nuggets (5.71), kababs (5.22), burgers (5.13) and lowest in fillets (4.99). WHC was also higher in meatballs (48.29%) than burgers (37.22%), fillets (35.89%), nuggets (32.41%) and lowest in kababs (27.83%). The moisture was higher in meatballs (70.21%) than fillets (68.80%), burgers (68.16%), kababs (64.19%) and lowest in nuggets (62.66%). Ash was higher in kababs (3.20%) than meatballs (3.07%), burgers (2.35%), nuggets (2.11%) and lowest in fillets (1.34%). The fat was higher in meatballs (10.89%) than burgers (10.76%), nuggets (8.65%), fillets (6.93%) and lowest in kababs (5.13%). Protein was higher in fillets (21.02%) than meatballs (13.57%), kabab (17.42%), burgers (15.64%) and lowest in nuggets (13.04%). The TVB was higher in chicken burgers (67.52 mg/100 g) than nuggets (58.16 mg/100 g), kabab (31.47 mg/100 g), meatballs (21.73 mg/100 g) and lowest in fillets (18.22 mg/100 g). The CC was higher in nuggets (6466.67 cfu/g) than burger (5016.66 cfu/g), fillets (4266.67 cfu/g), meatballs (3832.33 cfu/g) and lowest in chicken kabab (3155.66 cfu/g).

Keywords: Chicken meat products, quality assessment, food shops, Quetta, Balochistan

Introduction

The changing trends in lifestyle have shown significant impact on food consumption and consumer preference; consequently the fast food industry is under rapid development. Bakeries and fast food shops commonly poultry meat products such as burgers, nuggets, kababs, fillets and meatballs. However, invasion of chicken meat products in the food market has challenged to differentiate the producers for quality products related to consumer health. Poultry meat is a potential source of protein, vitamins and inerals for human diet. In Pakistan, poultry meat production during 2014-15, 2015-16 and 2016-17 was 1074, 1170 and 1276 thousand tons, respectively showing significant yearly growth (Govt. of Pakistan, 2017).

Protein and muscle tissue lipids of meat are important quality variables; they contribute significantly to meat nutritional characteristics. The consumption of poultry meat in the country is higher than other meat sources because of its palatability, digestibility, nutrient values and overall consumer acceptability. Generally, the poultry is relatively cheaper source of animal protein as compared to beef, mutton and fish meat; and the demand of poultry meat is continuously increasing. Under these circumstances, it is imperative and right of the consumers of poultry meat and its products to have quality meat products in the market (Barbut, 2002; Lukman *et al.*, 2009 and Samira *et al*., 2012).

Poultry meat is highly perishable and its quality deterioration is obvious, and even under freezing conditions its quality depreciates after certain period of time. Although, cooling temperature can delay microbial growth, but chemical reactions may lead to reduced loss of meat quality and improve the meat safety if the frozen products are consumed within limited period of time (Asghar *et al*., 1988). Quality products are those that meet the standard parameters for physical and chemical properties as well as safe in regards to microbial quality and sensory properties (Barbut, 2002). The chicken meat products may be examined for the nutritional quality and microbial safety parameters before their marketing (*et al*., 2009). The refrigerated chicken products in the markets should have an expiry date and microbial quality of these products may be critically maintained (Samira *et al*., 2012). Lipid oxidation and growth of microorganisms are the key factors cause changes that may result in loss of attractive fresh meat colour (Fautsman *et al*., 1989 and Gray & Pearson, 1987), change texture and nutritive value of chicken and its products (Pearson *et al*., 1983), forming harmful lipid oxidation products including malonaldehyde and cholesterol oxides (Perlo *et al*., 2005; Onibi & Atibioke, 2004; Raharjo & Sofos, 1993 and Shahidi, 1997). Bean & Griffin (1990) and Tompkin (1983) concluded that poultry products or meat ready to eat should have *Staphylococcus aureus* or *Closteridium perfringens* levels below 10^6 cfu/g; exceeding this level causes illness.

The chicken meat and its products such as chicken burgers, nuggets, fillets, kababs and chicken meatballs etc. are commonly available in frozen and refrigerated storage conditions at bakeries and food shops. Hence, this study was carried out to collect samples of chicken meat products marketed in Quetta city and determine physico-chemical characteristics and microbial quality of processed meat products.

Materials and Methods

Collection of samples

For examining the physico-chemical and microbial quality of chicken meat products, 30 samples were collected from different bakeries and food shops of Quetta city. The sample products included chicken nuggets, fillets, burgers, meatballs and kababs and these randomly collected samples were secured properly and brought to the Laboratory, Institute of Food Sciences and Technology, SAU Tandojam, Pakistan to determine the quality characteristics of the poultry products marketed in Quetta.

Equipments

pH meter: pH meter (Model Hl 8424, Hanna Instruments, Italy) was used for analysis of poultry meat samples for their pH value.

Refrigerated centrifuge machine: Centrifuge machine (Model Tj-6 Beckman USA) was used to centrifuge the samples for water holding capacity of poultry meat products.

Analytical balance: The analytical balance used for this analysis was branded as Adam, having AAA 2502 model and the balance was used for taking the weight of samples and media.

Refrigerator: Dawlance refrigerator (Model 9188 wbm, Pakistan) was used to keep poultry meat products.

Water bath: Water bath (Memmert WB 14, Germany) was used to analyze the poultry meat samples.

Hot air oven: A Germany fabricated Memmert 854 hot air oven was used to analyse moisture content of samples and sterilized the glasswares during present experiment.

Muffle furnace: Germany fabricated model Nevertherm Mod; L9/11/8KMof Muffle furnace was used to determine the ash content in meat.

Digital autoclave: Autoclave (YXQ SG 41, China) was used to sterilize the media, diluents and plastic utensils.

Digestion and distillation unit: Micro Kjeldhal digestion and distillation unit Mod 60300-01 branded as “LABCONCO” was used to determine the protein content in poultry meat products.

Soxhlet extraction unit: Soxhlet extraction unit (Lablin Melrose park, ILL) was used for fat extraction in meat products.

Incubator: Incubator (Heraeus D-6450 Hanau type B-6060) was used to incubate the inoculated petri dishes.

Colony counter: Colony counter (Intech, Model No 362-E, China) was used to count the colonies appeared on the petri dishes after required incubation.

Media

Plate count agar: Plate count agar (Oxoid Ltd, England) was used to enumerate the total viable count.

MacKonkey agar: MacKonkey Agar (Oxoid Ltd, England) was used to enumerate coliform count.

Diluent

Peptone water: England fabricated peptone water (Oxoid, Ltd.) was used as diluents for the preparation of samples during the analysis of microbiological quality of poultry meat products.

Physical characteristics

pH value

The meat samples were analysed for pH value following Ockerman (1985). 10g meat sample was taken and homogenized in 90ml distilled water, transferred into beaker. The electrode along with temperature probe was added to the sample. The reading appeared on pH meter base was noted as pH value of meat.

Water Holding Capacity (WHC)

The water holding capacity of meat samples was determined by the method suggested by Wardlaw *et al.,* (1973). The meat sample (8g) was put in a centrifuge tube adding 12ml NaCl solution of (0.6 Mm). The centrifugal tube (4 ^{0}C) centrifuged for 15 minutes at 10,000 rmp to decant and measure the supernatant. The water holding capacity was assumed from the difference between NaCl volume used and the supernatant.

$$\text{WHC (\%)} = \frac{\text{Before centrifuge weight- After centrifuge weight}}{\text{Before centrifuge weight}} \times 100$$

Chemical analysis:

Moisture, protein (Kjeldhal), fat (ether extraction) and ash contents of the meat were determined according to the methods as described by Association of Official Analytical Chemists (AOAC, 2000).

Total Volatile Base Determination (TVB)

The TVB was analysed following Kirk & Sawyer (1991) which is based on a semi-micro distillation procedure. Initially, by using sodium hydroxide, the solution was made alkaline and the bases were distilled with steam into standard acid and titrated back with standard alkali. The neutralised mixture was added with formaldehyde and the acid released is equivalent to the volatile bases other than trimethylamine.

Procedure

100±0.5g of sample was taken and homogenised using 300ml of 5% m/v trichloracetic acid. Homogeniser was run to get homogeneous slurry, centrifuged to achieve clear extract.

5ml of extract was transferred to a semi-micro-distillation apparatus, added 5ml sodium hydroxide solution (2Mm), steam distilled and collected in 15ml standard hydrochloric acid of 0.01Mm, added into the indicator solution, titrated to pale and pink point in the titration flask and then titrated the liberated acid with sodium hydroxide of 0.01Mm.

Calculation

$$\text{Total Volatile Base} = \frac{14(300+W)\times V_1}{500}$$

Where,

V_1 = volume of the first titration consumed standard acid

W = content of water in sample (mg/100g).

Coliform count

BSI (1993) was employed to count the coliform, the method used was developed by British Standards Institute (BSI). The 1 ml test sample of 10-1 to 10-5 dilution was transferred into sterile petri dish using 100µl dispensing pipette with sterile plastic tips and mixed with inoculum in 15 ml, 45±1^{0}C warm sterile MacKonkey agar. The solidified mixture was incubated at 30^{0}C for 24±2 hours. Parallel to that sterility was checked preparing control plates by 15ml similar medium. The colony counter was used to count dishes with >10 and <200 colonies. The following formula was used:

Bacterial count/ml of original solution = Colonies count on plate × Dilution factor

Statistical Analysis

Using ANOVA, significance of difference between chicken products for various characteristics was analysed; while LSD test was employed to compare the treatment means for statistical significance (P<0.05) using Student's Edition of Statistix (SXW) Analytical Software, USA (2005 Ver 8.1).

Results and Discussion

pH value

The samples of chicken meat products marketed in Quetta city were obtained and determined for their pH value (**Fig-1**). The chicken meatballs were found to be of highest pH value (6.10), and chicken nuggets were determined to be of 5.71 pH value; while pH value of chicken kababs was 5.22. However, lower pH value was determined for burgers were (5.13) and chicken fillets (4.99). The chicken meatballs were of higher pH than nuggets, kababs, burgers and fillets. This variation in pH value of chicken meat products may be associated with food ingredients used for preparation of these chicken meat products. These results are further supported by Qiao *et al.* (2001) who were of the experience that pH in chicken meat products varied due to variation in the preparation process as well as the quality of the meat and ingredients used for the processing.

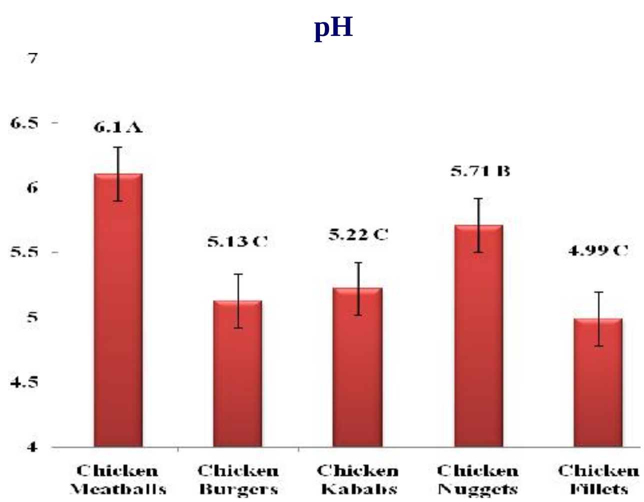

***Fig. 1*: pH values of chicken meat products**

Water holding capacity (WHC)

The water holding capacity of meatballs was higher than other broiler meat products (48.29%) determined such as burgers (37.22%), fillets (35.89%), nuggets (32.41%) and kababs (27.83%). It was further noted (**Fig-2**) that the water holding capacity of meatballs, nuggets, kababs, burgers and fillets made from chicken meat varied greatly (P<0.05) which was mainly because of variation in the ratio of meat and other ingredients used for development of these meat products. These results are in agreement with those of Qiao *et al.* (2001) who reported that there was a significant difference among the meat products for WHC. Lighter-than-normal meat was associated with low WHC. These results also indicated that differences in WHC of the processed poultry meat products may also be associated with the meat quality and age of the bird used for obtaining meat.

Mead (2004) reported that the WHC is changed with difference in the manufacturing process of chicken meat; whereas, Ismed *et al.* (2009) reported that nuggets made from broiler meat showed significant difference ($p<0.05$) between samples for WHC. This indicates that different producers may have varied recipes to develop meat products and products developed by different recipes might vary in water holding capacity.

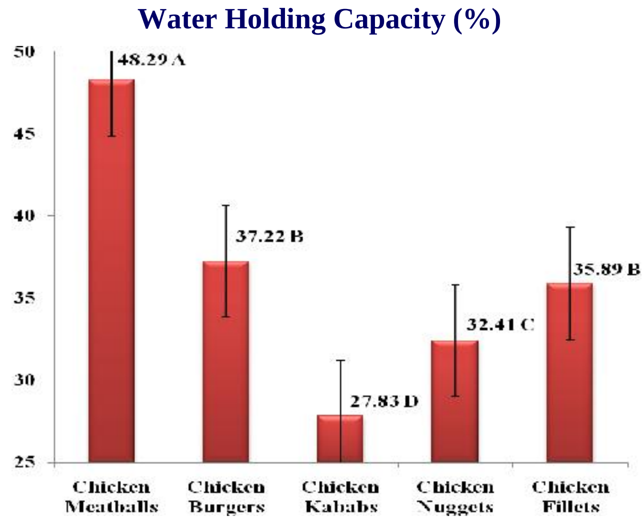

***Fig. 2*: Water Holding Capacity (%) of chicken meat products**

Moisture content (%)

The samples of different chicken meat products marketed in Quetta city were determined for moisture content and recorded significant variation ($P<0.05$) for this parameter. Moisture content was higher (70.21%) in meatballs as compared to fillets, burgers and kababs with 68.80, 68.16 and 64.19% moisture, respectively (**Fig-3**); while nuggets had lowest moisture (62.66%). Statistical similarity was analysed between chicken fillets and meatballs ($P>0.05$) or nuggets and kababs ($P>0.05$) for moisture content. Although, all these products were chicken based, but the variation in moisture content was considerable. The decrease in moisture content may be associated with addition of bread crumbs in chicken nuggets; moreover, due to higher emulsion stability in nuggets the moisture content remained lower. Similar results have also been reported by Ismed *et al.* (2009) who found that chicken nuggets showed significant variation ($p<0.05$) between samples for moisture (34.71-56.51%).

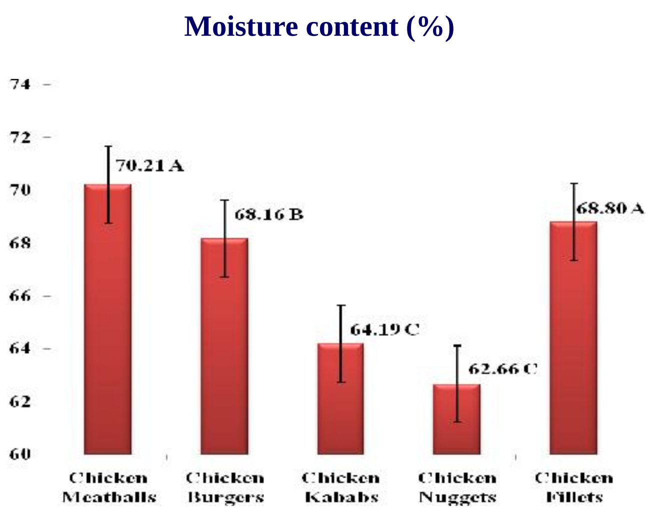

***Fig. 3*: Moisture content (%) of chicken meat products**

Ash content (%)

The determined ash content in marketed products based on chicken meat (nuggets, fillets, burgers, meatballs and kababs) varied significantly (P<0.05). The results (**Fig-4**) showed that the maximum ash content was determined in chicken kababs (3.20%), followed by meatballs, burgers and nuggets with 3.07, 2.35 and 2.11% ash, respectively; while fillets had lowest ash content (1.34%). The variation in ash content was mainly linked with a number of factors which mainly include use of common salt replacement instead of using salt substitute blend which generally lead to a significant decrease in ash content. There was a similarity in the findings of the present research and compared with studies of Carpenter *et al.* (2000) who reported 1.20-1.58% ash content in nuggets. The ash content in other chicken meat products may be due to the use of mechanically deboned chicken meat as compared to traditional deboned chicken meat (chicken meat deboned by hand). Similarly, Ismed *et al.* (2009) reported ash content ranged between 1.20-1.58%.

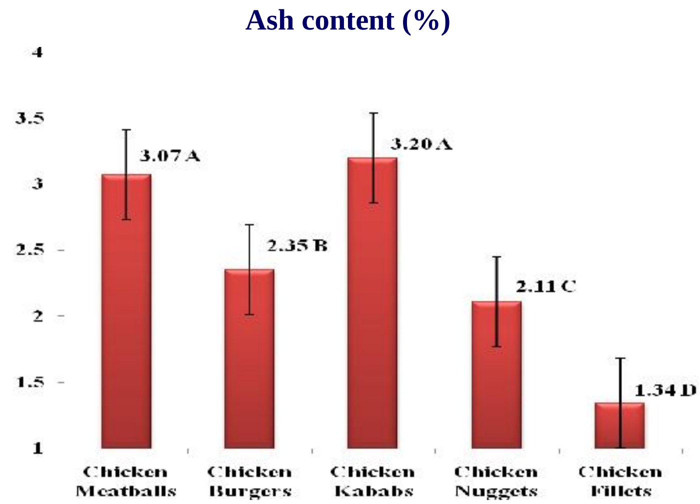

***Fig. 4*: Ash content(%) of chicken meat products**

Fat content (%)

The fat content (**Fig-5**) was maximum (10.89%) in meatballs, followed by burgers, nuggets and fillets having 10.76, 8.65 and 6.93% fat, respectively; while kababs contained minimum fat (5.13%). The variation in fat content is mainly associated with manufacturing process and the ingredients they use in this process. Generally, hot air frying and baking results in lower fat content in chicken meat products preparation as compared to their deep fat frying. Moreover, the variation in fat content may also be associated with use of common salt and instead of using salt substitute blend which may reduce the fat content markedly. However, Perlo *et al.* (2005) reported increased fat content (P<0.05) with addition of 40% chicken meat (mechanically deboned). Ngadi *et al.* (2007) reported changes in fat content in fillets, burgers, meatballs and nuggets are associated with changes in physical and chemical changes occur during frying process. Davidson and Burke (2009) concluded that chicken nuggets had the second highest fat content (14g/100g); whereas, Ismed *et al.* (2009) reported varied fat contents in chicken nuggets between samples (p<0.05) (18.14-25.00%). Tobin *et al.* (2012) reported that low fat meat samples became tough, less juicy and had greater cooking losses. Richard *et al.* (2013) reported that fats varied in chicken bone, nerve, and connective tissue. Suradkar *et al.* (2013) found that overall quality of nuggets and other chicken meat based products were associated with the preparation process and ingredients used for manufacturing.

Fat content (%)

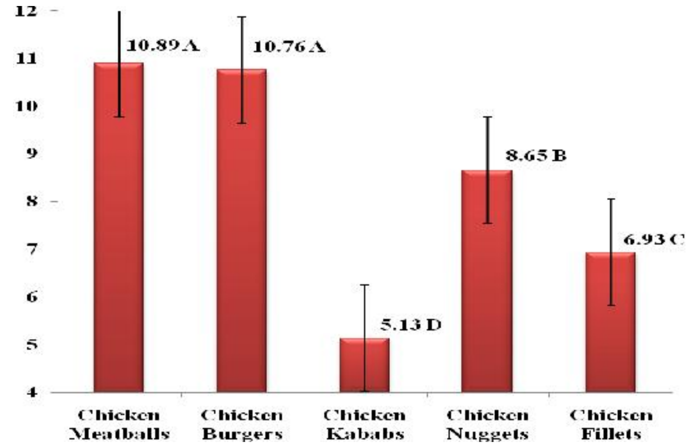

Fig. 5: **Fat content (%) of chicken meat products**

Protein content (%)

The analysis of chicken meat products for protein content suggested significant (P<0.05) variation in nuggets, fillets, burgers, meatballs and kababs (**Fig-6**). Chicken fillets contained higher protein level (21.02%), followed by meatballs, kababs and burgers with 17.42%, 15.64% and 13.57 % protein, respectively; while chicken burgers had lowest protein level (13.04%). This variation in the protein level among the chicken meat products may be associated with the variation in the materials used for their manufacturing. These results are in accordance with those of Perlo *et al*. (2005) who reported significant variation in protein content (P<0.05) in chicken products and such variation was mainly associated with the process of manufacturing of these products. Caceres *et al*. (2006) reported that protein content in nuggets ranged from 12.52 to 16.62%. The protein content in chicken products is mainly linked with quality of raw meat and its management the nuggets are processed. Similarly, Ismed *et al*. (2009) have also reported significant difference (p<0.05) in protein content (12.52-16.62%) of chicken nuggets.

Protein content (%)

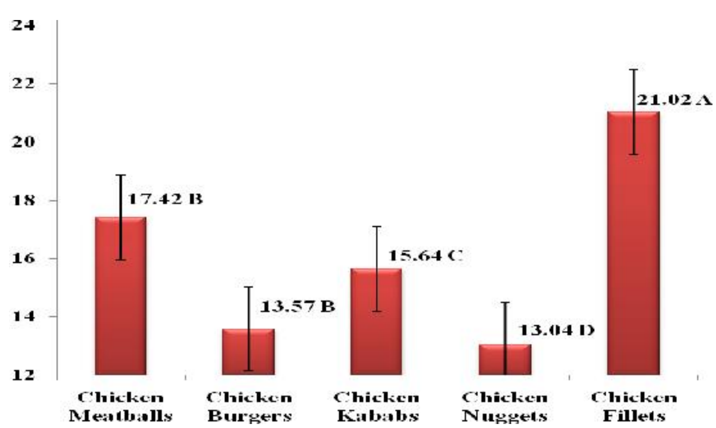

Fig. 6: **Protein content (%) of chicken meat products**

Total Volatile Base (TVB)

The TVB was significantly (P<0.05) higher (67.52 mg/100g) in chicken burger as compared to nuggets (58.16 mg/100g), kababs (31.47 mg/100g), meatballs (21.73 mg/100g) and fillets (18.22 mg/100 g). The comparison of meat products suggested that the TVB ranged between 18.22 to 67.52 mg/100g, which showed a great variation in TVB for the food items made from the same chicken meat. The TVB values estimated were the indicator of the degree of products freshness. The present research findings further coincide the results achieved by Richard *et al.* (2013) reported that some foods products in the markets had alarmingly higher contamination loads than the permissible limits. They determined that ground meat in warm seasons may have reduced food poisoning.

Total volatile base (mg/100 g)

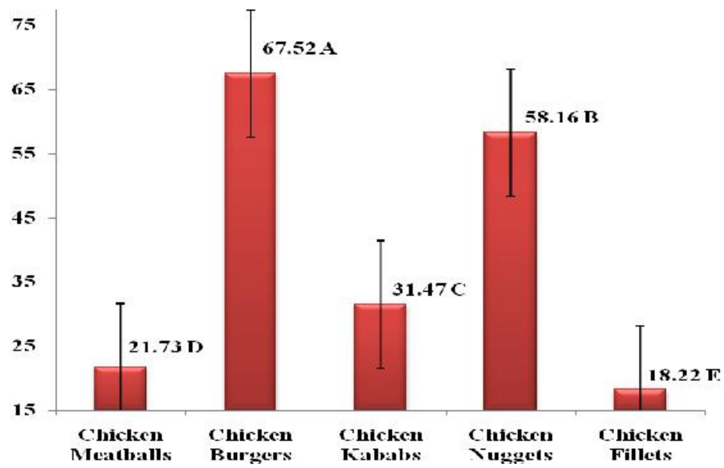

***Fig. 7*: Total volatile base of chicken meat products**

Coliform count (cfu/g)

The CC was highest (6467 cfu/g) in meatballs, followed by burgers (5017 cfu/g), fillets (4267 cfu/g), and meatballs (3832 cfu/g). The within products coliform count (between samples) were also higher which suggested that the chicken products manufactured by different processing units and bakeries had a great deal of variation. However, the present study suggested that chicken burgers were the safest chicken meat products from health point of view due to minimum coliform count. Similar findings have also been reported by Eglezos *et al.* (2008) who have reported a significant relationship (P<0.05) between seasons and coliform counts. There was no relationship in prevalence between different coliform species; the provided data are valuable and the data on bacteriological quality of raw, frozen chicken nuggets is well comparable with the findings of the present research. Altabari (2009) discussed food safety aspects related to the poultry industry and accounted for the development of awareness for issues related to food safety. They also found that significance of chicken meat quality as well as its products cannot be tolerated and there is need of education to communicate the essentiality of food safety for better human life.

Coliform count (cfu/g)

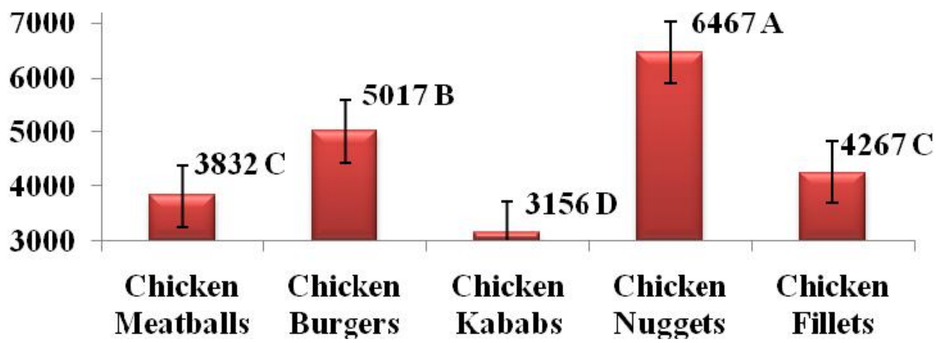

***Fig. 8*: Coliform count (cfu/g) of chicken meat products**

Conclusion

1. The meatballs were found to be of highest pH (6.10) and fillets of lowest pH of 4.99.

2. WHC of meatballs was found to be highest (48.29%) and chicken kababs had lowest WHC (27.83%).

3. Higher moisture (70.21%) was determined in meatballs and lowest (62.66%) in nuggets.

4. The ash level was highest (3.20%) in kababs and lowest in chicken fillets (1.34%).

5. High fat content (10.89%) was determined in meatballs and lowest was in kababs (5.13%).

6. The protein level was highest (21.02%) in chicken fillets and nuggets contained lowest protein level (13.04%).

7. The TVB determination was high (67.52 mg/100g) for burger and fillets showed the lowest TVB (18.22 mg/100g).

8. The coliform count was maximum (6467 cfu/g) in chicken meatballs and lowest in burgers (3156 cfu/g).

Recommendations

There should be clear recommendations for physical and chemical characteristics for all chicken meat products and before strict verification of quality parameters, the products must not be allowed to enter the market.

The determined total coliform count in chicken products manufactured by different processing units and bakeries showed exceptionally high variation had a great deal of variation (3156-6467 cfu/g); suggesting evaluation and strict monitoring to minimize the microbial load.

The microbial load needs to be minimized; and if total coliform count in chicken kababs was 3156 cfu/g, why the count exceeds to 6467 cfu/g in nuggets.

There is need to develop awareness among people and those involved in the poultry industry about the issues related to food safety.

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