

## EVALUATION OF QUALITY AND SAFETY PARAMETERS OF POULTRY MEAT PRODUCTS SOLD IN HYDERABAD MARKET, PAKISTAN.

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### Abstract

There are 30 Samples of five poultry meat products including chicken nuggets (S1), chicken fillets (S2), chicken burgers (S3), chicken meatballs (S4) and chicken kababs (S5) were collected from various retailers from Hyderabad market to evaluate quality and safety parameters. All the samples were investigated for pH, water holding capacity (WHC), moisture, ash, fat, protein content, total volatile base (TVB), total viable count (TVC) and coliform count (CC). Results revealed that chicken nuggets, fillets, burgers, meatballs and kababs varied significantly ( $P < 0.05$ ) for pH, WHC, moisture, ash, fat, protein contents, TVB and CC, and non-significant ( $P > 0.05$ ) for TVC. Highest pH (6.05) was recorded for meatballs, while lowest pH value (4.90) was recorded for chicken fillets. Among the investigated chicken products meatballs showed highest WHC (48.18%), while lowest was recorded in chicken kababs (27.72%). Moisture content was highest (70%) in meatballs, and lowest in chicken nuggets (62.45%). Maximum ash content (3.13%) was recorded in kababs, and lowest (1.27%) was confirmed in fillets. Fat content was maximum (10.78%) in meatballs, while minimum was recorded in kababs (4.97%). Highest protein level (20.25%) was found in kababs, while meatballs displayed lowest protein level (12.53%). Highest TVB (69.50 mg/100 g) was noted for fillets, while lowest in kababs (17.14 mg/100 g). In the microbiological examination of chicken products Total viable count (TVC) was highest in (7433.33 cfu/g) fillets, while lowest was noted in meatballs (6.43x10<sup>3</sup>cfu/g). The Coliform count (CC) was highest (6.3x10<sup>3</sup>cfu/g) in meatballs, while lowest values were verified in burgers (3.05x10<sup>3</sup> cfu/g). Total volatile base (TVB) and Total viable count (TVC) was greater in chicken fillets as compared to other products. This clearly indicates unhygienic circumstances at certain stages during manufacturing, processing, handling and storage of chicken meat products.

**Keywords:** Quality, Safety, Poultry Meat Products, Physico-chemical parameters, Microbial analysis.

### INTRODUCTION

It is a universal truth that, across numerous traditions Poultry meat remained a great part of human diet with high quality nutrients like, protein, vitamins and minerals. A lot of poultry meat products are consumed as food worldwide because; they are highly desirable, palatable, digestible and more importantly nutritious for all times. Moreover their price is cheap as compared to other types of meat i.e., beef and mutton. Poultry meat is composed of 22 to 25% protein and other products, including frankfurters, bologna and sausages may contain 17 to 20% protein, with 20% fat, and 60 to 80% water (Smith, 2001). Chicken Nuggets, chicken fillets, chicken burgers, chicken meatballs, and chicken kababs are the ready to cook and ready to eat products. These products have very uncomplicated preparation that makes them popular for consumers to use these as a quick meal. The masterpiece of these products is meat, usually from chicken, fish or combination with vegetables.

In Pakistan poultry meat adds 26.8 percent of the total meat production in the country. According to GOP, the broiler production during 2011 to 2012 was 34.82 million which increased to 37.25 million heads during 2012 to 2013. Total poultry meat production during 2011 to 2012 was 834000 tons which increased to 907000 tons during 2012 to 2013 (GOP, 2012). Like other meat types, chicken meat is subject to deterioration in quality because poultry meat is highly perishable with a limited shelf life even when stored at cooling temperatures. Cooling temperature can delay growth of microorganisms and chemical reactions which lead to reduction in the loss of meat quality and improve the meat safety.

Poultry meat contains high concentration of myoglobin and iron which are oxidation catalyst (Asgharet al., 1988). Lipid oxidation and microbial growth are two major factors which alters meat composition and reduces its colour (Fautsman et al., 1989), develops off-flavour (Gray and Pearson, 1987), changes in texture (Pearson et

al., 1983) and forms lipid oxidation products such as malonaldehyde (MDA) and cholesterol oxides (Onibi and Atibioko, 2004). Lipid oxidation is one of the primary causes of quality deterioration in raw and cooked meat products during refrigerated or frozen storage (Raharjo and Sofos, 1993; Shahidi, 1997). Moreover when meat is fried during the formulation of different products, its physical, chemical and sensory features changes (Townsend, 1971). Processed raw poultry meat naturally anchors bacteria, most of which are responsible for spoilage and deterioration (Waldroup, 1996).

United State Department of Agriculture confirms that bacterial species connected with chicken meat and its products mostly include: *Salmonella enteritidis*, *C. jejuni*, *S. aureus*, and *Listeria monocytogenes* (USDA, 2000). Furthermore ready to eat meat products with *Staphylococcus aureus* or *Clostridium perfringens* upto 10<sup>6</sup>cfu/g may cause illness, while the presence of *Salmonella* is considered to be a potential hazard (Tompkin, 1983). Poultry ranked first as cause in food poisoning with an incidence of 29.32%, followed by meat and cream with an incidence of 15.33 and 8.78%, respectively (Altabari and Al-Dughaym, 2002). In a study poultry products and mutton products were examined for their Total Viable Counts (TVC) by (Murugkaret al., 1993). They revealed higher TVC in pork products as compared to mutton and poultry products. In another study, the effects of different proportions of washed mechanically deboned chicken meat (WM) as a substitute for hand deboned chicken meat, on the physicochemical and sensory characteristics of chicken nuggets was analyzed by (Perloet al., 2005). They deciphered increased fat content whereas significant reduction in protein content when WM was added. Al-Dughaym and Al-Tabari (2010) found variation in the chemical composition of chicken meat products with high fat percentage with high

thiobarbituric acid value, which causes unacceptable flavor of the product

In their study Ismedet *et al.*, (2009) showed that chicken nuggets produced by different manufacturers, were dissimilar in chemical composition, colour, textural properties and sensory attributes. In Pakistan chicken products are important food served at almost all fast food restaurants and spots. A lot of food factories are active in Pakistan especially in Hyderabad city, which are increases the production and meets the growing demands of customers. The elevated degree of struggle among different companies, venture in advanced technologies has been essential to manufacture high quality foodstuffs. As a matter of fact physicochemical characteristics of poultry meat products sold in markets are the most significant factors for consumer acceptability. Since the Quality and Safety parameters of these poultry meat products sold in Hyderabad were not previously well studied and documented. So the objective of this study was to reveal quality and safety parameters of five poultry meat products sold in Hyderabad market.

## MATERIAL AND METHODS

Thirty samples of different poultry meat products including chicken nuggets (S1), chicken fillets (S2), chicken burgers (S3), chicken meatballs (S4) and chicken kababs (S5) were randomly collected from different shops of Hyderabad market during the year 2015. Samples were secured properly and immediately brought to the Laboratory of Food Sciences and Technology, Sindh Agriculture University Tandojam, to evaluate quality and safety parameters.

### Analysis of Physical Parameters

#### pH value

pH value of poultry meat product samples was examined according to the method as reported by Ockerman (1985). Briefly, A sample (10g) homogenized in distilled water (90 ml) was transferred into the beaker and electrode along with temperature probe. The constant reading appeared on pH meter base was noted and recorded as pH value for different meat products.

#### Water-holding capacity (WHC)

The method reported by Wardlaw *et al.*, (1973) was used to determine water holding capacity (WHC) of poultry meat products. Approximately 8g meat sample was placed in a centrifuge tube together with 0.6 M NaCl solution (12ml). The tube was centrifuged (4°C) at 10,000 RPM for 15 min, and the supernatant was decanted and measured. The difference between volumes of NaCl (0.6 M) used and supernatant was recorded as WHC using the formula.

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

### Analysis of Chemical Parameters

#### Moisture content

Moisture content was observed according to the method of Association of Official Analytical Chemistry (AOAC, 2000). The fresh poultry meat sample (5g) was transferred in pre-weighed flat bottom aluminum dish, which was transferred to a hot air oven at 101±1°C for 3-4 hours. Dried sample was then placed in desiccators having silica gel as desiccant. After 1hour, the dish was weighed. Moisture content was calculated by applying the following formula.

$$\text{Moisture (\%)} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Where,

W<sub>1</sub> = weight of empty dish

W<sub>2</sub> = weight of dish + sample

W<sub>3</sub> = weight of dish + dried sample

#### Ash content

Ash percentage was determined by Gravimetric method as described by AOAC (2000) using the muffle furnace. The meat sample (5g) was transferred in pre-weighed crucible and transferred to muffle furnace at (550°C) for 4-5 hours. Ashed sample was transferred to desiccator having silica gel as desiccant. After 1 hour, the dish was weighed. Ash content was calculated by using the following formula:

#### Fat content

Fat content was extracted in soxhlet extraction unit as described by AOAC (2000). Briefly, the soxhlet extractor was set with reflux condenser and distillation flask which was previously dried and weighed. Dried sample (2 g) was taken in to fat free extraction thimble and placed in extraction apparatus. Then ether (150 ml) was transferred in to extraction flask and condenser was joined and placed on electric heater in order to boil the solvent gently. Extraction was carried out for 6 hours. The solution was removed and fat content was calculated by using the following formula.

$$\text{Fat\%} = \frac{W_1 - W_2}{W_3} \times 100$$

#### Protein content

Protein content was determined according to the method described by AOAC (2000). Sample (2 g) was digested using Micro-Kjeldhal digester in the presence of catalyst (0.35 g copper sulfate and 7 g sodium sulfate/potassium sulfate) where sulfuric acid (20-30 ml) was used as an oxidizing agent and diluted with distilled water (250 ml). The diluted sample (5 ml) was distilled with 40% NaOH solution using Micro-Kjeldhal distillation unit where steam was distilled over 2% boric acid (5 ml) containing an indicator bromocresol green for 3 min. The ammonia trapped in boric acid was determined by titrating with 0.1N HCl. Nitrogen percentage was calculated using the following formula:

$$1.4 (V_1 - V_2) \times \text{Normality of HCl} \times 250$$

Protein (%)

$$\frac{\text{Weight of sample taken} \times \text{Volume of diluted sample}}{\text{Volume of diluted sample}}$$

Where,

V<sub>1</sub> = titrated value

V<sub>2</sub> = blank sample value. The protein percentage was determined by conversion of nitrogen percentage of protein by using conversion factor (6.25) assuming that all the nitrogen in meat was presented as protein i.e. protein percentage = N% × CF.

#### Total volatile base

The method described by Kirk and Sawyer (1991) for determination of TVN based on a semi-micro distillation procedure was used with little modification. Extracts or solutions were made alkaline with sodium hydroxide. The bases are steam distilled into standard acid and back titrated with standard alkali. Formaldehyde was added to the neutralized mixture and the acid released is equivalent to the volatile bases other than trimethylamine. 100g ± 0.5 of prepared sample was weight into a homogenizer with 300ml of 5 percent m/v trichloroacetic acid. The homogenizer was run to obtain a uniform slurry, and then centrifuge to obtain a clear extract. By using pipette 5ml of the extract was transferred to a semi-microdistillation apparatus. 5ml 2M sodium hydroxide solution was then added. Steams distilled were collected in 15ml 0.01M standard hydrochloric acid. Indicator solution (1 percent rosolic acid in 10 percent v/v ethanol) was added. Finally titrated to a pale pink and point within the titration flask. The liberated acid was titrated with 0.01M sodium hydroxide.

$$\text{Total base nitrogen} = \frac{14 (300+W) \times V_1}{500} \quad \text{mg/100g}$$

### Microbial analysis

#### Preparation of glassware's

New glassware's were immersed in HCl solution (5%) overnight to remove the surface alkali and then taken out of HCl solution (5%) and rinsed with 6-8 changes of normal tap water followed by 4 changes of distilled water. Used glass wares, such as conical flask, test tube, beaker, Petri dishes, pipette, and measuring cylinder were autoclaved for one hour and then washed in basin containing a solution of detergent (Surf). After over-night soaking, in solution of low concentration of chromic acid solution (10%) to remove any greasy material, every single item was brushed and rinsed in tap water. All the materials were then again rinsed with 6-8 changes of normal tap water followed by 4 changes of distilled water. All the glass wares were then drained, placed upside down in drying oven at 55°C for 30 min and left to dry before capping / plugging for sterilization. All dried Petri dishes were wrapped in grease proof brown paper in batches of 5-6. Glass pipettes were plugged with cotton plug and then wrapped in brown paper in batches of 5 and 10; while other glassware like conical flasks, measuring cylinders and test tubes were sealed individually with aluminum foil. These were then sterilized at 170-175°C for 1-2 hours through dry heat (Hot air oven). Furthermore, the glassware with plastic or aluminum caps and all those could not resist dry heat in oven were sterilized in an autoclave at temperature of 121°C with 15lb pressure for 20 minutes (IDF, 1991). Peptone water (Oxoid, Ltd. England) (15g) was dissolved in distilled water (1L) and distributed in bottle (90ml) and/or in test tubes (9ml). The bottles/tubes were capped or plugged with cotton and autoclaved (121°C) for 15 min. The sterilized diluents were stored (4-8°C) till use.

#### Preparation of media

##### Plate count agar

Plate count agar (17.5 g) was dissolved in distilled water (1L) and heated to boil with frequently stirring. Transparent medium was distributed into test tubes (12-15ml) and plugged with cotton. These were further sterilized in an autoclave (121°C) for 15 min and stored till use.

##### Preparation of test samples

Minced meat sample (10g) was reconstituted aseptically with 90 ml of 0.1% peptone water (Oxoid England) in a laboratory blender to make 10<sup>-1</sup> dilution. Further a series of dilution were prepared accordingly.

##### Total viable count (colony count method at 30°C)

Total viable counts were counted according to the method of International dairy federation (IDF, 1991). Pre prepared test sample (1ml of 10<sup>3</sup>, 10<sup>4</sup>, 10<sup>5</sup>, 10<sup>6</sup> or 10<sup>7</sup>) dilution was transferred into sterile petri dishes in duplicate through sterile graduate pipette or dispensing pipette (1000µl) with sterile plastic tips and warm (45±1°C) sterile plate count agar medium (15ml) was mixed with inoculums. The mixture was allowed to solidify and incubated (30°C) for 72±2 hours. Parallel to that, control plates were also prepared using similar medium (15ml) to check the sterility. The dishes containing more than 30 and/or fewer than 300 colonies were selected and counted using colony counter. The result was calculated using following formula:

$$N = \frac{\sum c}{(n_1 + 0.1 \times n_2) d}$$

##### Coliform count (Colony count method at 30°C)

Coliform counts were enumerated according to the method of British Standards Institute (BSI, 1993). Pre prepared test sample (1ml) of 10<sup>1</sup>, 10<sup>2</sup>, 10<sup>3</sup>, 10<sup>4</sup> and / or 10<sup>5</sup> dilution was transferred into sterile petri dishes through dispensing pipette (100µl) with sterile plastic tips and warm (45±1°C) sterile MacConkey agar (15ml) was mixed with inoculums. The mixture was allowed to solidify and incubated (30°C) for 24±2 h. Parallel to that control plates were also prepared using similar medium (15ml) to check its sterility. The dishes containing more than 10 and / or fewer than 200 colonies were selected and counted using colony counter. The result was calculated using formula.

$$\text{Number of bacteria / ml of original solution} = \text{No. of colonies on plate} \times \text{dilution factor}$$

##### Statistical Analysis

The data was subjected to analysis of variance (ANOVA) on different company products and in case of significant differences appeared among the means, the least significant differences were computed using computer packages i.e. Student Edition of Statistix (SXW) (copyright 2005, Analytical Software, USA).

## RESULTS AND DISCUSSIONS

### pH value

The analysis of variance shown in (Table-1) suggested significant (P<0.05) variation in pH of different chicken meat products. The experimental results indicated chicken meatballs with highest pH value (6.05) ranging 5.98 to 6.15 while chicken nuggets with pH value (5.66) ranging between 5.26 to 6.00 and pH value of chicken kabab was (5.17) ranging between 4.76 to 5.79. Among the examined chicken meat products, chicken burgers have lower pH value (4.97) ranging 4.87 to 5.01 while the chicken fillets were found with lowest pH value (4.94) ranging 4.82 to 5.00. Statistically the differences in pH values between chicken kababs, chicken burgers and chicken fillets were non-significant (P>0.05) and significant when these products were compared with chicken meatballs and chicken nuggets.

Previous studies reported that variations in color occurs in the production of chicken raw meat that might affect pH (Barbut, 1997) and another studies found that scalding methods also effects meat pH expressively (Zhuang *et al.*, 2013).

### Water holding capacity (WHC)

All chicken meat products were able to withstand water when pressure was imposed by means of centrifuge. The data in (Table-2) shows water holding capacity of chicken meat products. Chicken meatballs have highest water holding capacity (48.18%) which was in the range of 47.15 – 49.00%, followed by chicken burgers and chicken fillets 37.11 (35.32-39.11%) and 35.78 (34.35-37.86%), respectively. The chicken nuggets determined to have lower water holding capacity of 32.30% ranging between 30.11-34.35%; while the chicken kababs were found to have lowest water holding capacity (27.72%), ranging between 25.14-29.77%. Statistically the differences in water holding capacity between chicken fillets and chicken burgers were non-significant (P>0.05) and significant when these products were compared with other products analyzed. It was further noted that WHC in chicken meatballs, chicken nuggets, chicken kababs, chicken burger and chicken fillets varied greatly. Increased Water holding capacity in different chicken products were also obtained by Ismed *et al.*, (2009). Water holding capacity is the vital parameter that resolves stability of meat products to withstand water when pressure is imposed in a centrifuge

(Thomsen *et al.*, 1988). Another study found that water holding capacity values remains proportional with premature content of products, where products with elevated fat content have little water holding capacity values (Mittal and Barbut, 1994).

**Table(1) pH of different poultry meat products marketed in Hyderabad**

Product Name	Samples						Mean
	R1	R2	R3	R4	R5	R6	
Chicken Nuggets (S1)	5.35	5.26	6.00	5.98	5.38	5.97	5.66 b
Chicken Fillets (S2)	4.89	4.82	5.00	4.97	5.00	4.96	4.94 c
Chicken Burgers (S3)	4.98	4.87	4.97	4.97	5.01	5.01	4.97 c
Chicken Meatballs (S4)	6.02	6.05	6.13	6.15	5.99	5.98	6.05 a
Chicken Kababs (S5)	5.00	5.03	5.79	5.66	4.76	4.76	5.17 c

S.E.± 0.1317

LSD 0.05 0.2747

LSD 0.01 0.3747

Mean values followed by similar letters are not significantly different from each other at alpha level 0.05.

**Table(2) Water holding capacity (%) of different poultry meat products marketed in Hyderabad**

Product Name	Samples						Mean
	R1	R2	R3	R4	R5	R6	
Chicken Nuggets (S1)	33.31	30.11	31.00	31.00	34.35	34.00	32.30 c
Chicken Fillets (S2)	36.88	37.86	35.55	35.51	34.52	34.35	35.78 b
Chicken Burgers (S3)	39.11	35.32	37.34	37.35	36.79	36.77	37.11 b
Chicken Meatballs (S4)	49.00	49.00	47.15	47.35	48.22	48.35	48.18 a
Chicken Kababs (S5)	29.77	28.76	25.14	26.00	28.33	28.34	27.72 d

S.E.± 0.7524

LSD 0.05 1.5694

LSD 0.01 2.1408

Mean values followed by similar letters are not significantly different from each other at alpha level 0.05.

#### Moisture content (%)

Data in (Table-3) indicates that moisture content was highest (70.00%) in chicken meatballs which was in the range of 68.34-71.32%, followed by chicken fillets and chicken burgers having average moisture content of 68.59 and 67.95%, ranging between 66.47-70.11 and 66.76-69.05%, respectively. Chicken kababs contained lower moisture content (63.95%) ranging between 62.12-66.00%; while chicken nuggets were determined to have lowest moisture content (62.45%), ranging between 60.55-66.81%. Statistically, similarity ( $P>0.05$ ) in moisture content was determined between chicken fillets and chicken meatballs or between chicken nuggets and chicken kababs; while significant ( $P<0.05$ ) when these groups of chicken products were compared with each other. Differences in moisture content might be due to variation in meat type used. The moisture content of light meat found to be greater than the moisture content of normal and dark chicken breast

fillets. Furthermore there was no any significant relationship between pH and moisture content found in studies. (Boulianne and King, 1998).

**Table(3) Moisture content (%) of different poultry meat products marketed in Hyderabad**

Product Name	Samples						Mean
	R1	R2	R3	R4	R5	R6	
Chicken Nuggets (S1)	66.81	64.11	61.34	61.34	60.55	60.55	62.45 c
Chicken Fillets (S2)	70.03	70.11	69.72	68.73	66.47	66.47	68.59 a
Chicken Burgers (S3)	68.88	66.76	67.00	67.00	69.05	69.03	67.95 b
Chicken Meatballs (S4)	71.32	70.32	70.44	71.00	68.56	68.34	70.00 a
Chicken Kababs (S5)	63.34	64.34	65.44	66.00	62.12	62.44	63.95 c

S.E.± 0.8652

LSD 0.05 1.8047

LSD 0.01 2.4617

Mean values followed by similar letters are not significantly different from each other at alpha level 0.05.

#### Ash content (%)

Table-4 shows ash content of different meat products. Highest (3.13%) ash content was noted in chicken kababs that was in the range of 2.98-3.42%, followed by chicken meatballs and chicken burgers having average ash content of 3.00 and 2.28%, ranging between 2.98-3.01 and 2.13-2.37%, respectively. Chicken nuggets contained lower ash content of 2.04% ranging between 1.12-1.36%; while chicken fillets were with minimum ash content (1.27%), ranging between 1.12-1.36%. Statistically, similarity ( $P>0.05$ ) in ash content has been suggested by LSD test between chicken kababs and chicken meatballs; while significant ( $P<0.05$ ) when these items were compared with rest of the products. Moreover, there was marked variation in the ash content between chicken kababs and chicken fillets. Variations in ash content of chicken meat products were also reported by several researchers Field (1996), suggesting that the a mechanically deboned chicken meat contains higher ash content while traditional deboned chicken meat have lower ash content because of process of mechanical deboning, Another logic is that the chicken bones crumpled and mixed into the mince which causes higher content of ash in meat products.

#### Fat content (%)

The data in (Table-5) exhibits fat content of different meat products. Fat content was maximum (10.78%) in chicken meatballs that was in the range of 10.15-11.92%, followed by chicken burgers and chicken nuggets having average fat content of 10.64 and 8.65%, ranging between 9.73-12.00 and 7.95-9.05%, respectively. The chicken fillets was holding lower fat content of 6.82% ranging between 6.35-7.24%; while the chicken kababs contained minimum fat level (4.97%), ranging between 4.36-5.97%. Statistically, the differences in fat content as demonstrated by LSD test; while significant ( $P<0.05$ ) when these items were compared with rest of the chicken meat products examined in this experiment. These results showed that fat content between chicken meat products ranged 4.97 to 10.78 which reflects a wide range of difference. The variation in fat content is mainly associated with manufacturing process and the ingredients they use in this process.

**Table(4) Ash content (%) of different poultry meat products marketed in Hyderabad**

Product Name	Samples						Mean
	R1	R2	R3	R4	R5	R6	
Chicken Nuggets (S1)	2.13	2.11	2.00	2.00	1.99	1.98	2.04 c
Chicken Fillets (S2)	1.12	1.12	1.34	1.36	1.35	1.35	1.27 d
Chicken Burgers (S3)	2.35	2.35	2.13	2.14	2.36	2.37	2.28 b
Chicken Meatballs (S4)	3.00	3.00	2.98	2.98	3.01	3.01	3.00 a
Chicken Kababs (S5)	3.41	3.42	3.00	2.99	2.98	3.00	3.13 a

S.E.± 0.0751  
LSD 0.05 0.1567  
LSD 0.01 0.2138

Mean values followed by similar letters are not significantly different from each other at alpha level 0.05.

Previous studies reported that appropriate manipulation with broiler chicken diet could modify fatty acid profile in meat and increase its nutritional value (Valstaet *al.*, 2005). It has been assumed that the quality of meat and mainly fatty acid profile both in breast and leg muscles mostly depends on components contained in mixtures (Swierczewska *et al.*, 2000). Chemical composition of breast meat is governed by the type of the diet. Another study found that the organic chickens had carcasses with a higher breast and drumstick percentages and lower abdominal fat levels (Castellini *et al.*, 2012). Appropriateness of a product and rise in toughness of meat product is affected by the decrease in fat content (Giese, 1996). Nutritionally, fat is a rich cause of energy in the diet providing 9 Kcal/g. Nevertheless, consumption of fat may increase risk of obesity, certain cancer types, and increased blood cholesterol and heart infections. With effect to these negative reasons many organizations such as American Heart Association, American Cancer Society and World Health Organization have suggested limiting total fat consumption which is not more than 30% of overall calories (Jimenez, 1996).

#### Protein content (%)

The results in Table-6 shows protein content of different meat products in which highest (20.25%) protein content was confirmed in chicken kababs that was in the range of 19.17-21.35%, followed by chicken fillets and chicken nuggets having average protein content of 17.03 and 16.92%, ranging 15.80-18.02 and 15.95-18.00%, respectively. Chicken burgers were holding lower protein content (14.97%) ranging between 13.32-16.36%; while the chicken meatballs were having lowest protein content (12.53%), ranging between 11.15-14.30%. Statistically, the variation in protein content as suggested by LSD test between chicken nuggets and chicken fillets were non-significant ( $P > 0.05$ ); while significant ( $P < 0.05$ ) when compared with rest of the products examined. It was further indicated that the protein level between chicken meat products ranged between 12.53 to 20.25 percent showing great difference. In a study broiler chicken was fed with mixtures of higher protein content which showed higher body mass and protein percentage in muscle tissue as compared to broilers fed with diet protein content (Barteczko *et al.*, 2008). In the present study, the difference in the protein content of various chicken products may be due to feeding of the diets formulated with different levels of protein content.

**Table(5) Fat content (%) of different poultry meat products marketed in Hyderabad**

Product Name	Samples						Mean
	R1	R2	R3	R4	R5	R6	
Chicken Nuggets (S1)	9.05	9.00	8.95	8.98	7.95	7.95	8.65 b
Chicken Fillets (S2)	6.64	6.65	7.23	7.24	6.35	6.83	6.82 c
Chicken Burgers (S3)	11.98	12.00	10.01	10.33	9.73	9.78	10.64 a
Chicken Meatballs (S4)	11.92	11.92	10.22	10.34	10.15	10.15	10.78 a
Chicken Kababs (S5)	5.97	4.98	5.00	5.12	4.39	4.36	4.97 d

S.E.± 0.3021  
LSD 0.05 0.6301  
LSD 0.01 0.8594

Mean values followed by similar letters are not significantly different from each other at alpha level 0.05.

**Table(6) Protein content (%) of different poultry meat products marketed in Hyderabad**

Product Name	Samples						Mean
	R1	R2	R3	R4	R5	R6	
Chicken Nuggets (S1)	16.10	15.95	18.00	17.13	17.35	16.98	16.92 b
Chicken Fillets (S2)	17.35	17.14	18.01	18.02	15.88	15.80	17.03 b
Chicken Burgers (S3)	13.32	14.00	15.00	15.00	16.12	16.36	14.97 c
Chicken Meatballs (S4)	11.15	11.88	14.00	14.30	11.92	11.93	12.53 d
Chicken Kababs (S5)	19.35	19.17	20.32	20.32	21.35	21.00	20.25 a

S.E.± 0.5125  
LSD 0.05 1.0690  
LSD 0.01 1.4581

Mean values followed by similar letters are not significantly different from each other at alpha level 0.05.

#### Total volatile base (TVB)

The TVB results were shown in Table-7 which indicates highest TVB (69.50 mg/100 g) in chicken fillets ranging between 68-71 mg/100 g, followed by chicken meatballs and chicken burgers with TVB of 60.17 and 29.45 mg/100 g, ranging between 56-64 and 28.93-30.35 mg/100 g, respectively. Relatively lower TVB index was observed for chicken nuggets 20.83 mg/100 g ranging between 20.00-22.34 mg/100 g; while the TVB was lowest in case of chicken kababs (17.14 mg/100 g), ranging between 16.00-18.36 mg/100 g. Statistically, the variation in TVB as demonstrated by LSD test among all the poultry meat products were linear and significant ( $P < 0.05$ ). The comparison of meat products suggested that the TVB ranged between 17.14 to 69.50 mg/100 g, which showed a great variation in TVB for the food items made from the same chicken meat.

#### Total viable and coliform count (cfu/g)

The data in (Table-8) shows TVC of different chicken meat products. TVC was relatively higher ( $7.4 \times 10^3$  cfu/g) for chicken fillets ranging between  $5.6 \times 10^3$ - $9.1 \times 10^3$  cfu/g, followed by chicken burgers and chicken nuggets with TVC of  $7.4 \times 10^3$  and  $7.06 \times 10^3$  cfu/g, ranging between  $6.5 \times 10^3$ - $8.5 \times 10^3$  and  $5.4 \times 10^3$ - $8.8 \times 10^3$  cfu/g, respectively. Relatively lower TVC was observed in chicken kababs ( $6.43 \times 10^3$  cfu/g) ranging between  $5.9 \times 10^3$ - $7.6 \times 10^3$  cfu/g; while lowest in chicken

meatballs ( $6.43 \times 10^3$  cfu/g), ranging between  $6.1 \times 10^3$ -

**Table(7) Total volatile base (mg/100 g) of different poultry meat products marketed in Hyderabad**

Product Name	Samples						Mean
	R1	R2	R3	R4	R5	R6	
Chicken Nuggets (S1)	19.98	20.00	21.34	22.34	20.98	20.35	20.83 d
Chicken Fillets (S2)	71.00	69.00	70.00	70.00	69.00	68.00	69.50 a
Chicken Burgers (S3)	28.98	28.93	29.00	29.33	30.08	30.35	29.45 c
Chicken Meatballs (S4)	64.00	64.00	60.00	59.00	58.00	56.00	60.17 b
Chicken Kababs (S5)	18.32	18.36	17.14	17.00	16.00	16.00	17.14 e

S.E.± 0.9347

LSD 0.05 1.9497

LSD 0.01 2.6595

Mean values followed by similar letters are not significantly different from each other at alpha level 0.05.

$6.8 \times 10^3$ cfu/g. Although the differences in TVC were apparently higher between chicken meat products, due to higher variation within the products. Hence, the results were considered as non-significant on the basis of probability level ( $P > 0.05$ ). The coliform bacteria results were shown in Table-9 which indicates that the mean coliform count was highest ( $6.3 \times 10^3$ cfu/g) in chicken meatballs ranging between  $5.7 \times 10^3$ - $7.7 \times 10^3$ cfu/g, followed by chicken fillets and chicken kababs with coliform count of  $4.9 \times 10^3$  and  $4.13 \times 10^3$  cfu/g, ranging between  $4.3 \times 10^3$ - $5.5 \times 10^3$  and  $3.8 \times 10^3$ - $4.5 \times 10^3$  cfu/g, respectively. Coliform count was decreased in chicken nuggets samples ( $3.71 \times 10^3$  cfu/g) ranging between  $3.1 \times 10^3$ - $5 \times 10^3$ cfu/g; while the coliform count was lowest in chicken burgers ( $3.05 \times 10^3$  cfu/g), ranging between  $2.3 \times 10^3$ - $3.7 \times 10^3$ cfu/g. The coliform count amongst the chicken meat products was in the range of  $3.05 \times 10^3$  to  $6.3 \times 10^3$  cfu/g, showing considerable product to product difference.

In the light of these results it could be reasonable to say that most diseases associated with food occur due to the contamination from those who handle food. Few protective measures like sanitary food handling, proper cooking and chilling can avoid illness associated with food products. Prior to shipping the chickens to market they pass through a variety of stages of processing. These stages may be very critical to the microbial quality of chicken, such stages include scalding, immersion and irradiation. Altabari (1984) stated that *S. aureus* enterotoxin causes food poisoning which could occur when minced meat, containing large amount of the bacteria during processing, is stored at temperatures elevated than  $14^\circ\text{C}$ . To avoid this problem it is necessary to give attention to the initial bacterial contamination. In this regard keeping meat at temperatures lower than  $9^\circ\text{C}$  is suitable. Keeping minced meat at room temperature for hours is a common practice and this disposes the poisoning caused by *S. aureus*. El-Khateib et al., (1988) in their study recorded a total bacterial count of 106 to 107 cfu/g for chicken burger.

**Table(8) Total viable count (cfu/g) of different poultry meat products marketed in Hyderabad**

Product Name	Samples						Mean
	R1	R2	R3	R4	R5	R6	
Chicken Nuggets (S1)	$7.8 \times 10^3$	$8.8 \times 10^3$	$7.6 \times 10^3$	$6.9 \times 10^3$	$5.4 \times 10^3$	$5.9 \times 10^3$	$7.06 \times 10^3$ a
Chicken Fillets	$5.6 \times 10^3$	$6.6 \times 10^3$	$7.2 \times 10^3$	$9.1 \times 10^3$	$8.3 \times 10^3$	$7.8 \times 10^3$	$7.43 \times 10^3$ a

(S2)							
Chicken Burgers (S3)	$8.5 \times 10^3$	$8.3 \times 10^3$	$6.6 \times 10^3$	$6.5 \times 10^3$	$7.1 \times 10^3$	$7.4 \times 10^3$	$7.40 \times 10^3$ a
Chicken Meatballs (S4)	$6.1 \times 10^3$	$6.3 \times 10^3$	$6.8 \times 10^3$	$6.8 \times 10^3$	$6.4 \times 10^3$	$6.2 \times 10^3$	$6.43 \times 10^3$ a
Chicken Kababs (S5)	$7.6 \times 10^3$	$7.4 \times 10^3$	$7.0 \times 10^3$	$6.9 \times 10^3$	$6.7 \times 10^3$	$5.9 \times 10^3$	$6.91 \times 10^3$ a

S.E.± 566.18

LSD 0.05 1181.0

LSD 0.01 1611.0

Mean values followed by similar letters are not significantly different from each other at alpha level 0.05.

**Table(9) Coliform count (cfu/g) of different poultry meat products marketed in Hyderabad**

Product Name	Samples						Mean
	R1	R2	R3	R4	R5	R6	
Chicken Nuggets (S1)	$3.3 \times 10^3$	$3.1 \times 10^3$	$5.0 \times 10^3$	$3.8 \times 10^3$	$3.4 \times 10^3$	$3.7 \times 10^3$	$3.71 \times 10^3$ c
Chicken Fillets (S2)	$4.4 \times 10^3$	$4.3 \times 10^3$	$5.5 \times 10^3$	$5.2 \times 10^3$	$5.1 \times 10^3$	$4.9 \times 10^3$	$4.90 \times 10^3$ b
Chicken Burgers (S3)	$2.3 \times 10^3$	$2.8 \times 10^3$	$3.0 \times 10^3$	$3.1 \times 10^3$	$3.4 \times 10^3$	$3.7 \times 10^3$	$3.05 \times 10^3$ d
Chicken Meatballs (S4)	$7.7 \times 10^3$	$6.8 \times 10^3$	$6.1 \times 10^3$	$5.9 \times 10^3$	$5.8 \times 10^3$	$5.7 \times 10^3$	$6.33 \times 10^3$ a
Chicken Kababs (S5)	$4.5 \times 10^3$	$4.3 \times 10^3$	$3.9 \times 10^3$	$4.2 \times 10^3$	$4.1 \times 10^3$	$3.8 \times 10^3$	$4.13 \times 10^3$ c

S.E.± 350.51

LSD 0.05 731.15

LSD 0.01 997.31

Mean values followed by similar letters are not significantly different from each other at alpha level 0.05.

## CONCLUSION

On the basis of analysis of quality and safety parameters, difference in compositional quality of various poultry meat products was evident. This may be due to differences in the type of ingredients used, different formulations and different processing techniques (such as immersing, mixing, and frying). It was observed that chicken kababs were rich in protein whereas, chicken meatballs were high in WHC, fat and moisture content. It was further observed that TVB was higher in chicken fillets as compared to the other meat products. It is therefore reasonable to conclude that Total volatile base (TVB) and Total viable count (TVC) was greater in chicken fillets as compared to other products. This clearly indicates unhygienic circumstances at certain stages during manufacturing, processing, handling and storage of chicken meat products.

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