Readers Insight
Publisher of open access books and journals
PJMLS
Print ISSN: 2707-4471. Online ISSN: 2707-448X

Research Article	Pak-Euro Journal of Medical and Life Sciences
DOI: 10.31580/pjmls.v4i4.2175	Copyright © All rights are reserved by Corresponding Author
Vol. 4 No. 4, 2021: pp. 235-244	
www.readersinsight.net/pjmls	
Submission: December 01, 2021	**Revised:** December 19, 2021 **Accepted:** December 26 , 2021

EVALUATION OF PHYSICO-CHEMICAL CHARACTERISTICS OF MEAT AND EDIBLE OFFALS OF CATTLE

Amjad Ali Wazir[1ǂ], Muhammad Altaf Hussain[2*ǂ], Qurban Ali Shah[2], Ibrar Ahmed[3], Sajjad Ahmad[2], Ihsanullah Kakar[2],Tahmina Shah[4],Feroza Soomro[4], Inam Ullah Wazir[5], Ayaz Qadir[2]

[1]**Livestock Research and Development Station**, Pharpur, Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan

[2]**Faculty of Veterinary and Animal Science,** Lasbela University of Agriculture, Water, and Marine Sciences, Uthal- 90150, Balochistan, Pakistan

[3]**Key Laboratory for Animal Disease Control and Pharmaceutical Development,** College of Veterinary Medicine, Northeast Agricultural University, 600 Changjiang Road, Xiangfang District, Harbin 150030, PR. China.

[4]**Faculty of Animal Husbandry and Veterinary Sciences,** Sindh Agriculture University, Tandojam, Pakistan.

[5]**Livestock and Dairy Development Department (Research),** Peshawar, Khyber Pakhtunkhwa, Pakistan

***Corresponding Author:** Dr. Muhammad Altaf Hussain. Email: draltafdawar@gmail.com

ǂ Authors Contributed equally

Abstract

Present study was conducted to evaluate the physico-chemical characteristics of meat and edible offals (liver and heart) of local breeds of cattle. The samples of cattle meat and edible offals (liver and heart) each of 20 randomly collected from the local market of Hyderabad. The samples of meat and offals were examined for pH, water holding capacity, cooking loss, drip loss, moisture, protein, fat and ash at the Department of Animal Products Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam. The average pH (6.02±0.01), water holding capacity (24.90±0.18%), cooking loss (36.85±0.24%), and drip loss (3.05±0.02%) were found significantly high (P<0.05) in liver than that of muscle tissue (5.74±0.03, 23.61±0.42%, 32.77±0.65% and 1.95±0.16%, respectively) and heart (5.62±0.3, 20.86±0.29%, 30.65±0.26% and 1.69±0.13%, respectively) of the cattle. The average moisture content (75.68±0.22%) was significantly higher (P<0.05) in heart of cattle, followed by the muscle tissue (74.54±0.32%) and liver (71.94±0.11%). While the protein content in muscle tissue (20.65±0.13%) was found comparatively higher (P<0.05) followed by heart (19.89±17%) and liver (19.18±0.19%). The average fat content (6.04±0.13%) in liver was remarkably (P<0.05) higher than that of heart (3.01±0.02%) and muscle tissue (2.57±0.09%). The average ash content (1.25±0.006) of liver was significantly higher (P<0.05) than that of muscle tissue (1.15±0.03%) and heart (1.08±0.05%). It is concluded that the muscle meat of cattle consumed at Hyderabad city was high in Protein content whereas low WHC, drip loss, cooking loss and pH indicated low quality in the term of palatability. While high level of fat in edible offals (liver and heart) support them as energetic and palatable products for consumption.

Keywords: *Meat, Offals, Cooking loss, Protein content, Palatability*

INTRODUCTION

Livestock play an important role in the contribution of valuable food such as milk and meat for human beings. Meat of course, is an important livestock product, which in its widest sense includes all those parts of the animals that are used as a food. It is the animal flesh of skeletal muscle, associated fat and other edible tissues and organs such as: liver, heart, brain, bone marrow, kidneys and lungs. It is very high in protein and also rich in all the essential amino acids and found to be a good source of zinc, vitamin B_{12},

selenium, phosphorus, niacin, vitamin B_6, iron and riboflavin (1). It is very low in carbohydrates and fibers but varies widely in fat depending on the species and breed of animal, feeding system and the methods of butchering. However, good meat has a uniform color, firm and elastic texture being barely moist to touch and having a scarcely perceptible clean odor (2). Besides meat, the edible parts like liver and heart are also a good source of protein, fat, iron, zinc, riboflavin, niacin, vitamin A (3). Among meat, the cow meat is generally considered as the red meat and contains appreciable concentration of essential nutrients like protein (19%), intra muscular fat (2.5%), carbohydrate (1.2%), other soluble non-protein substances (2.3%) and water (75%) (4).

It has been reported in Pakistan that approximately 3379 thousand tons of meat per annum has been produced and among this, cattle contributes 1829 thousand tons of beef (5). Moreover, most of the meat produced in the country is not of good quality due to the slaughtering of culled, diseased, old, and poor performing animals. Besides, it is produced through unrecognized sector which is in the hands of butchers with very little knowledge of nutritional status of meat and edible offals. Other important factors which may influence on the quality of meat include age, sex, feed type, nutritional status, slaughtering methods, body weight, physiological conditions, physical activity of animal, postmortem aging and microbiological load on carcass in slaughter house and/or at meat shops (6, 7). In regard to meat quality, the physico-chemical characteristics like pH, water holding capacity, cooking loss, drip loss, moisture, protein, fat and ash are assumed to be very important attributes, which could not properly be achieved under above said conditions. Therefore, quality of meat must be considered when assessing overall value. In fact, the meat and edible offals are widely consumed as an important source of animal protein in the diet in the developing countries. Surprisingly, few studies have been undertaken on physico-chemical properties of meat and edible offals. Thus, the purpose of present study was to evaluate the physico-chemical characteristics of meat and edible offals of cattle available in local market at Hyderabad, Sindh, Pakistan.

MATERIALS AND METHODS

EXPERIMENTAL PROCEDURE

The muscle meat samples of cattle meat and edible offals (liver and heart) each of 20 were randomly collected from the local meat market of Hyderabad Sindh, and brought to the laboratory of Department of Animal Products Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam. The samples were analyzed for physical characteristics like pH value, water holding capacity (WHC), cooking loss and drip loss, and chemical characteristics like protein, fat, and ash content.

ANALYSIS OF PHYSICAL CHARACTERISTICS

pH VALUE

The pH value of cattle meat and edible offals (liver and heart) was determined according the method reported earlier (8). The samples of meat/edible offals (10g) homogenized in distilled water (90 ml) were transferred to beaker and an electrode along with temperature probe was inserted into the sample. The constant reading appeared on pH meter base was noted and recorded as pH value of samples of cattle meat and edible offals (liver and heart).

WATER-HOLDING CAPICITY (WHC)

For the determination of WHC (8g) of meat/edible offals; samples were placed in a centrifuge tube together with 0.6 M NaCl solution (12ml). The tube was centrifuged (4 ^{0}C) at 10,000 rpm for 15 min, and the supernatant was decanted and measured according to the method reported by (9). The difference between the volumes of NaCl (0.6 M) used and supernatant was recorded as WHC.

COOKING LOSS

Approximately 20g sample of meat/edible offals was placed in a polyethylene bag and heated for 1 hr in a water bath at 80 ^{0}C to achieve an internal temperature of 72 ^{0}C for the determination of cooking loss

of cattle meat and edible offals (liver and heart) was measured according to method reported by (10). Cooked out was drained and cooked mass was cooled and weighed to determine the weight loss.

DRIP LOSS

Drip loss was measured as described by (11). Cattle meat/edible offals (50g) were placed in polyethylene bag with sealed cover and refrigerated (4 ^{o}C) for 24 hrs. The sample was wiped and dried with filter paper and weighed. The difference among actual weight of sample and weight after refrigeration was assumed as drip loss.

ANALYSIS OF CHEMICAL CHARACTERISTICS

MOISTURE CONTENT

Moisture content was observed according to the method of Association of Official Analytical Chemist (12). The fresh minced cattle meat/edible offal sample (5g) was transferred in pre-weighed flat bottom aluminum dish, which was transferred to hot air oven at 101 ± 1°C for 3-4 h. Dried sample was then placed in desiccator containing silica gel as desiccant and after I h, the dish was weighed for final weight.

For the determination of meat protein content, sample (2 g) was digested using Micro-Kjeldhal digester in the presence of catalyst (0.35 g copper sulphate and 7 g sodium sulphate) where sulfuric acid (30 ml) was used as an oxidizing agent. The digested sample was diluted with distilled water (250 ml). Then 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. Samples were determined according to the method of (12).

While protein percentage was determined by conversion of nitrogen percentage to protein assuming that all the nitrogen in meat/edible offals was presented as protein i.e. protein percentage = N% × conversion factor (CF). Whereas, CF is 100/N% in protein of meat and meat products *i.e.* 16.00.

FAT CONTENT

Total fat content (TF) was extracted in Soxhlet Extraction Unit as described by (12). Soxhlet Extractor was set with reflux condenser and distillation flask which was previously dried and weighed. Dried meat/edible offals sample (2 g) was taken into fat free extraction thimble and placed in extraction apparatus (soxhlet). Then ether (150 ml) was poured into extraction flask and condenser was joined and placed on electric heater in order to boil the solvent gently. Extraction was carried out for 6 h. The solution was removed and dried, sample was dried and weighed for fat content

ASH CONTENT

Ash percentage was determined by Gravimetric method as described by (12) using muffle furnace. The fresh minced meat/edible offals sample (5g) was transferred in pre-weighed crucible and transferred to muffle furnace (550 ^{0}C) for 5 h. Ash sample was transferred to desiccators having silica gel as desiccant. After 1 h, the dish was weighed and the ash content was calculated

STATISTICAL ANALYSIS

The data obtained was subjected to analysis of variance using the computer programme i.e. Student Edition of Statistix (SXW) (Copyright 2005, Analytical Software, USA). In case of any significant difference appeared, the least significant difference (LSD) among the means was computed to observe the significant variation among the groups.

RESULTS

PHYSICAL CHARACTERISTICS OF CATTLE MEAT AND EDIBLE OFFALS (LIVER AND HEART)

pH VALUE

The pH value of cattle muscle tissue, heart and liver was determined, and results are presented in Fig. 1 Panel (A). It was observed that the pH value in muscle tissue of cattle ranged from 5.53 to 6.01 and in heart from 5.46 to 5.80, while in liver it was in between 5.91 to 6.10. The coefficient of variation (CV) was observed as 1.96% in muscle tissue, 1.81% in heart and 1.02% in liver. Moreover, the average pH value of the liver (6.02±0.01) was comparatively higher (P<0.05) than that of muscle tissue (5.74±0.02) and heart (5.62±0.02). It was evaluated that the pH value of muscle tissue, heart and liver of cattle was significantly (P < 0.05) different from each other (LSD, 0.05).

WATER-HOLDING CAPICITY (WHC)

Cattle muscle tissue, heart and liver was analyzed for water holding capacity, and the results are depicted in Fig. 1 Panel (B). A wide variation was observed within muscle tissue, heart and liver. The water holding capacity of muscle tissue ranged from 19.87 to 25.40% (average, 23.60±0.41%), while in heart it varied between 19.03 to 23.01.0% (average; 20.86±0.29%) and in liver from 23.55 to 24.90% (average; 24.90±0.18%). The CV percent was found to be high in muscle tissue (6.84%) followed by heart (5.35%) and liver (2.84%). The results of statistical analysis (ANOVA) illustrated that the differences in WHC of cattle muscle tissue, heart and liver were significant (P<0.05). Further, the LSD (0.05) showed that the water holding capacity of liver was remarkably (P<0.05) higher followed by muscle tissue and heart of cattle.

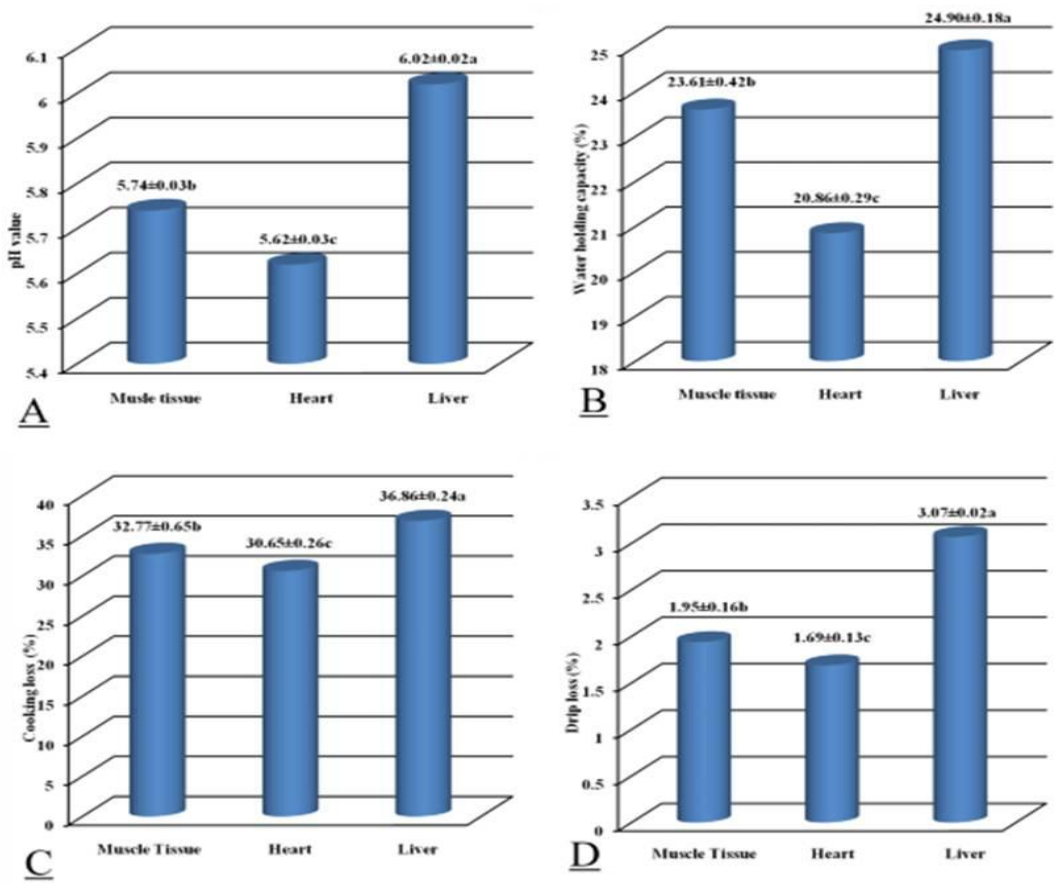

Fig. 1. Graphical presentation of physical characteristics of cattle meat and edible offals. The physical characteristics have been determined as pH values (A) Water holding capacity (B), Cooking loss (C) and Drip loss (D) in cattle meat and edible offals (Heart and Liver). The bars of the graphs represent percentage relative values of meat, heart and liver of different physical characteristics.

COOKING LOSS

Cooking loss of cattle muscle tissue, heart and liver was evaluated, and results are shown in Fig. 1 Panel (C). The range of cooking loss was noted from 28.45 to 36.35%, 29.07 to 33.02% and 35.45 to 38.32%, in muscle tissue, heart and liver respectively. The CV percent was found to be higher for muscle tissue (7.66) followed by heart (3.30) and liver (2.51). Statistically (LSD, 0.05), the cooking loss of liver (36.85±0.23%) was significantly higher (P<0.05) than that of muscle tissue (32.77±0.64 %) and heart (30.64±0.26 %).

DRIP LOSS

The drip loss of muscle tissue, heart and liver of cattle meat was examined and results are summarized in Fig. 1 Panel (D). The average drip loss in liver was 3.05±0.02% (range, 2.93 to 3.21%), which was remarkably (P<0.05) higher than that of cattle muscle tissue as 1.94±0.15% (range, 1.04 to 2.98%) and heart 1.69±0.13% (range, 1.03 to 2.68%). The CV of muscle tissue was recorded higher (30.94%) followed by heart (30.58%) and liver (2.92%). Statistical analysis (ANOVA) showed significant difference (P<0.05) in drip loss among the muscle tissue, heart and liver. Further, the result of LSD (0.05) revealed that the drip loss of muscle tissue and heart was found to be statistically similar: LSD (0.05) = 1.217 and SE ± = 0.603.

CHEMICAL CHARACTERISTICS OF CATTLE MEAT AND EDIBLE OFFALS

MOISTURE CONTENT

Moisture content in muscle tissue, heart and liver of cattle was analyzed, and results are presented in Fig. 2 Panel (A). The moisture content was observed in a range of 72.03 to 75.87% in muscle tissue, 73.09 to 76.73 in heart and 71.03 to 72.90% in liver. CV% was found to be high in muscle tissue (1.69) followed by heart (1.15) and liver (0.61%). The average moisture content was noted as 75.68±0.22% in heart, 74.54±0.32% muscle tissue and 71.94±0.11% in liver. When the mean values were computed for LSD (0.05), it was observed that the moisture content in heart was significantly (P<0.05) higher followed by muscle tissue and liver of the cattle.

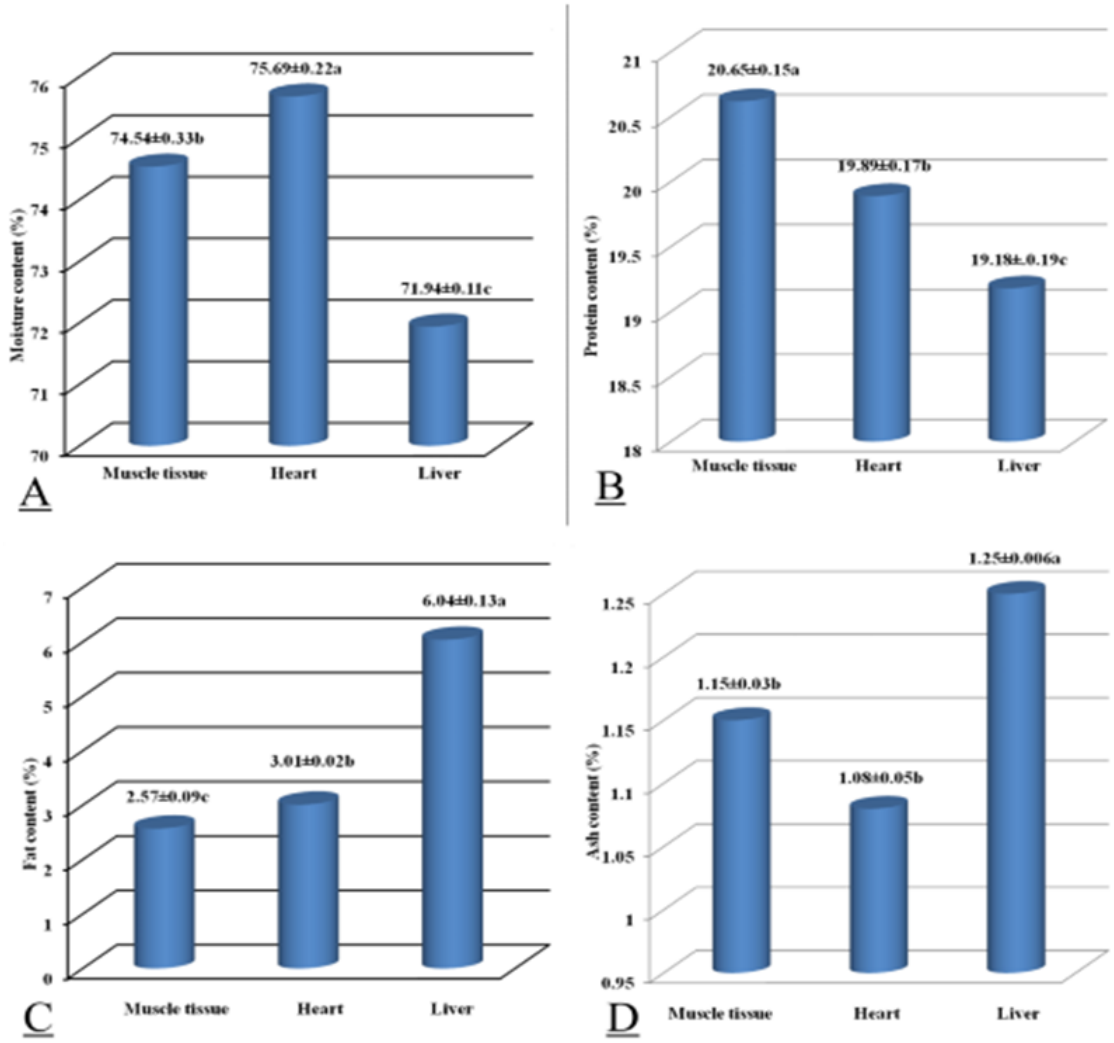

Fig. 2. Graphical presentation of chemical characteristics of cattle meat and edible offals. The chemical characteristics have been determined as moisture content (A), Protein content (B), Fat content (C) and Ash content (D) in cattle meat and edible offals (Heart and Liver). The bars of the graphs represents percentage relative values of meat, heart and liver of different chemical characteristics**.**

PROTEIN CONTENT

Protein content in meat, heart and liver of cattle was analyzed, and results are depicted in Fig. 2 Panel (B). Protein content varied between 19.87 to 21.73.67% in muscle tissue, 18.20 to 20.57% in heart and 18.32 to 20.10% in liver. CV was found to be high in liver (3.80%) followed by heart (3.42%) and muscle tissue (2.87%). While data was computed for least significant difference (LSD; 0.05) among the mean values, result showed that the average protein content in muscle tissue (20.65±0.15%) was comparatively higher ($P<0.05$) followed by heart (19.89±0.17) and liver (19.18±0.18%). Further analysis of variance (ANOVA) revealed that protein content of muscle tissue, heart and liver was significantly ($P<0.05$) different from one another.

FAT CONTENT

Fat content in meat, heart and liver of cattle was analyzed, and results are shown in Fig. 2 Panel (C). A wide variation in fat content within cattle muscle tissue heart and liver was observed. Fat content in cattle muscle tissue ranged between 1.98 to 3.10%, heart 2.87 to 3.20% and liver 4.90 to 7.01%. CV was found to be high in muscle tissue (14.42%) followed by liver (8.92%) and heart (3.15%). The results (ANOVA) showed that the fat content of liver, heart and muscle tissue was significantly ($P<0.05$) different from each other. Further, the LSD revealed that the average fat content in liver was remarkably ($P<0.05$) highest (6.04±0.13) followed by heart (3.01±0.02%) and muscle tissue (2.57±0.09%).

ASH CONTENT

Ash content of muscle tissue, heart and liver of cattle was analyzed and results are shown in Fig. 2 Panel (D). The ash content varied from 0.95 to 1.32% in muscle tissue, while in between 1.00 to 1.81 % in heart and 1.23 to 1.31% in liver. The CV was noted higher in heart (18.59%) compared to that of muscle tissue (10.49%) and liver (1.83%). The average ash content of liver (1.25±0.006%) was significantly higher ($P<0.05$) than that of muscle tissue (1.15±0.03%) and heart (1.08±0.05%). Further it was observed that the ash content was found to be similar ($P>0.005$) in muscle tissue and heart (LSD 0.05).

DISCUSSION

Meat is an important constituent of the human diet since time immemorial. It is a rich source of protein containing essential amino acids in a sufficient, proper and desirable proportion in a digestible form. Offals are used to denote all the materials of economic value produced from slaughter of food animals which are not a part of dressed carcass and are classified in to two major groups; i.e. edible and non edible offals depending upon their use for human food. Edible offals are sometimes referred to as variety meat or fancy meats and are being underutilized as compared to lean meat (13). The efficient utilization of these by products is essential and supports an economical and viable meat production system (14). Such as liver is an economic and rich source of essential nutrient like protein, iron and zinc (15). In present study the physical and chemical characteristics of meat and edible offals (liver and heart) were studied. The pH values were recorded higher in liver of cattle (6.02±0.02) as compared to that of muscle tissue and heart. It is of interest to note that pH is a result of postmortem biochemical changes which continue during the storage period, and depends upon the amount of glycogen breakdown to lactic acid during anaerobic glycolysis (16).

Present results are in consistent with the findings of (17), who reported high value of pH (6.45) in liver. The muscle and heart pH (5.74±0.03 and 5.62±0.03, respectively) observed in the present study are relatively near to ultimate pH (5.5) as reported by (16). These results indicate that meat or edible offals under present investigation were collected from stressed cattle. This stress could be of physical such as extremes of temperature, noise, confinement and crowding or of psychological such as the breakdown of social groups and mixing with unfamiliar animals, unfamiliar or noxious smells or novel environments (16), and stress experienced by the live animal at and before slaughter may have caused such type of declining pattern in pH values of meat and edible offals (liver and heart). Although the pH value of liver under present study also declined, but it could not reach to isoelectric point (16).

Water holding capacity is the ability of meat tissue to retain free water (not chemically bound), when the external forces such as cutting and chopping is applied. Present finding revealed that water holding capacity was remarkably higher ($P < 0.05$) in liver (24.90±0.18%) followed by muscle tissue and heart. These results are in line with findings of (13) who also reported lower ($P < 0.05$) water holding capacity in heart as compared to that of skeletal muscle. It has been reported that water holding capacity of meat remarkably affected by age, pH, fat content and time elapsed after slaughtering (18). Moreover, the relationship between pH and water holding capacity has been well established (19). The water holding capacity is increased at high muscle pH. The reason behind this could be high pH, the net negative charges of myofilaments result in strong repulsive electrostatic forces between the filaments which push the filaments apart, swells up the lattice and hence increase the space where the water is lodged (19). This was expected to happen in the present study. The trend of increase/decrease of WHC apparently correlates with pH resulted in the present investigation.

Cooking loss is usually measured to observe the release of moisture from meat after cooking. In the present study, cooking loss was remarkably higher ($P>0.05$) followed by muscle tissue and heart. It could be argued that cooking loss in meat is assumed to be a loss of water that muscles originally contained. At cooking temperature 65˚C, the cooking loss was reported to be about 30% and at 80˚C over 40% (16). Moreover, the findings are in line with that of reported by (18) who observed 31% to 38% cooking loss in different age groups of Pakistani cattle breeds. Whereas the cooking loss examined in the present study was not in agreement with the results of (20) who recorded 25.10% cooking loss in muscles of cattle breeds. (21) reported the cooking loss 32.21±0.66% in muscle of intact male which is relatively similar to that observed in muscle meat of present investigation, whilst the meat of castrated male and heifer, showed apparently lower cooking loss of 29.24±0.98% and 28.64±0.98%, respectively from that of observed in present study, which is particularly important in measuring the physical attributes of meat.

Drip loss is a measure of weight loss of meat which is practically important in measuring the physical quality attributes of meat. In the present study, the average drip loss in liver (3.07±0.002%) of cattle was remarkably higher ($P<0.05$) than that of muscle tissue and heart. It has been reported that drip formation is a function of water holding capacity of meat, drip is dilute solutions. It drips more when WHC is poor and less when it is high (19). In the present study, WHC of liver tissue appeared high as compared to muscle tissue or heart, which does not correlate with the drip loss in liver in the present investigation. In another study, it has been stated that a reduced extent of acidification and high ultimate pH result in low drip loss (19). Moreover in the present investigation results are inversed and both the pH value and drip loss of liver appeared higher as compared to that of muscle tissue or heart. The reason behind the trend of drip loss resulted in the present study is unknown and need further investigation. Moreover, drip loss in the present study disagree with the findings of (21), who reported lower drip loss in meat of castrated male, and female cattle (1.79±0.24% and 1.8±0.19% respectively) from that of liver and muscle tissue and higher than that of heart investigated in the present study.

In the present study, average moisture content in cattle meat was 74.54±0.33%, which is in agreement to the earlier findings (21) who recorded the moisture content of meat of dairy cattle cross breeds in a range of 72.99 to 75.69%. While two workers (13) and (21) also found relatively similar moisture content in buffalo skeletal meat (75.85%), to that of observed in the present study for muscle tissue. The moisture content in liver of cattle averaged 71.94±0.11% in present study. This is apparently resemblance to the earlier findings of (17) who reported 71.92% moisture content in the liver of buffalo meat. In the present study the moisture content in heart of cattle was determined with an average of 75.69±0.22%. Relatively similar moisture content 75.33±1.53% in heart of young male cattle was reported by (23), whilst (13) recorded the higher (78.42) moisture content in heart of buffalo. Nevertheless, moisture content observed in the present study was comparable higher in heart (75.69±0.22%) followed by muscle tissue and liver of cattle. Reasons behind this might be the moisture content which is inversely proportional to that of fat in similar commodity (16 and 24), and this trend probably be happened in the present study. For instance, the moisture content in liver appeared lower but the fat content was at the peak, while in heart with low fat content reveled elevated moisture content.

The protein content of muscle tissue of cattle (20.65±0.15%) was significantly higher (P<0.05) followed by heart and liver. These results are in line with the findings of (23), who reported the protein content in cattle muscle in a range of 21.5±0.30 to 22.07±0.45% and in heart of cattle 19.27±0.42% and in liver 18.44% of protein (17). Similarly (25) also observed relatively similar (19.98 to 20.57%) protein content in cattle meat. Moreover, (3) supported the trend range of present results observed for muscle tissue and edible offals. However, he found the higher protein content in lean meat of cattle (23.2%) followed by liver 20.0%) and heart (18.2%) of cattle. Muscle growth, or protein accretion, occurs when protein synthesis exceeds protein degradation. The significant protein accretion occurs probably due to hyperplasia (increase in cell number), hypertrophy (increase in cell size) and a decrease in protein degradation while the protein synthesis levels remain the same (26).

In present study, the fat content was found considerably (P<0.05) higher in liver (6.04±0.13%) as compared to heart and muscle tissue of cattle. Similar results were reported by (3), for fat content in cattle meat and edible offals (liver and heart) and noted the higher fat content in liver (8.5%) followed by heart (3.2%) and meat (2.57%). It is of interest to note that higher fat content could improve the extremes of juiciness (i.e. dryness and succulence) which in term encompasses the edible offals (liver and heart) rather palatable that is preferred by majority of consumers (16). Present results for fat content in muscle tissue of cattle disagreed with the findings of (18), who reported higher (3.03%) fat content in meat of Pakistani cattle breeds (Sahiwal, Red Sindhi and Dhani). The low level of fat content in cattle meat (muscle tissue) under present investigation could be characterized with lack of succulence with less juiciness, and this is obviously not palatable for consumers. Moreover, (27) support the present findings, who reported the range of fat content in four raw meat cuts (buttock, flank, loin blade steak, and shoulder blade steak) of creole cattle in between 1.06 to 2.74%.

In present study ash content was higher in liver (1.25±0.01%) followed by muscle tissue and heart of cattle. This might be due to presence of higher level of mineral contents such as iron, copper, manganese, phosphorous and potassium in liver, which is rich source of these minerals than that of lean tissue (28). These findings are in agreement with that observed by (29) who reported that the liver of cattle breeds had approximately 13 and 19% more ash content than that the heart and muscle, respectively of cattle breeds. Present results are also in consistent with the findings of (18), who reported 1.16 and 1.32% ash content in muscle tissue and liver of cattle, respectively. The concentration of ash in heart of cattle observed in the present study was within the range of (23), who reported ash content in between 1.06 to 1.17% in heart of cattle.

CONCLUSION

Based on the findings of present investigation, it can be inferred that protein content in muscle tissue was higher than the heart and liver. Fat content in liver was significantly (P<0.05) higher than heart and muscle tissue. Moisture content was high in heart followed by muscle tissue and liver. Ash content in liver was significantly (P<0.05) higher than heart and muscle tissue.

The pH values were significantly different (P<0.05) in muscle tissue, heart and liver. Water holding capacity, drip loss and cooking loss was significantly higher in liver (P<0.05) than muscle tissue and heart.
Based on the findings, it could be suggested that protein content muscle meat of cattle at Hyderabad city Sindh Pakistan were elevated, could be utilized as proteinous food for consumption, while its poor water holding capacity suggest to improve pre and post slaughter measures during production of meat. The liver and heart of cattle with high fat content and improve WHC gives the opportunity to utilize edible offals (Liver and heart) as energetic and palatable products. Further study is required on micronutrients (Amino acids, fatty acids, minerals, vitamins etc) so that consumers may be guided properly to select the meat of their choice. Microbial quality may be determined to provide safe meat to the humans by reducing/preventing human health hazards. More studies need to be done based on sex, breed, age and management practices to characterize Physico-chemical Characteristics of meat and edible offals of cattle. Awareness program among the farmer and steps should be taken for keeping the aseptic conditions at butcher's shops for providing good quality meat to consumers.

References:

1. Cross AJ, Leitzmann MF, Gail MH, Hollenbeck AR, Schatzkin A, Sinha R. A prospective study of red and processed meat intake in relation to cancer risk. PLoS medicine. 2007; 4(12):e325.
2. Anonymous. Meat. The Columbia Encyclopedia, Sixth (Edition) 2008.
3. Williams, P., V. Droulez. And G. Levy. Nutrient composition of Australian red meat. Food .2007;64(4), 113-119.
4. Lawrie, R. A. and D. A. Ledward. Lawrie's meat science (7th ed.). Cambridge: Woodhead Publishing Limited. Chapt. 2006. 4:75.
5. Farooq. Agriculture: Livestock and Poultry Production. Economic Survey of Pakistan. Bureau of Statistics (Economic Wing), Ministry of Food, Agriculture and Livestock, Government of Pakistan, Islamabad. 2013.
6. Owen JE, Norman GA, Philbrooks CA, Jones NS. Studies on the meat production characteristics of Botswana goats and sheep—Part III: Carcase tissue composition and distribution. Meat science. 1978;2(1):59-74.
7. Li LQ, Tian WQ, Zan LS. Effects of age on quality of beef from Qinchuan cattle carcass. Agricultural Sciences in China. 2011; 10(11):1765-71.
8. Ockerman, H.W. Quality control of Post-Mortem Muscle Tissue Dept of Animal Sciences. The Ohio State University; Columbus, OH, USA. 1985.
9. Wardlaw FB, McCaskill LH, Acton JC. Effect of postmortem muscle changes on poultry meat loaf properties. Journal of Food science. 1973; 38(3):421-3.
10. Kondaiah N, Anjaneyulu AS, Rao VK, Sharma N, Joshi HB. Effect of salt and phosphate on the quality of buffalo and goat meats. Meat Science. 1985;15(3):183-92.
11. Sen AR, Santra A, Karim SA. Carcass yield, composition and meat quality attributes of sheep and goat under semiarid conditions. Meat science. 2004;66(4):757-63.
12. AOAC. Meat and Meat products. In: Official Methods of Analysis. Association of Official Analytical Chemists Inc. Gaithersburg, U.S.A. 2000.
13. Verma AK, Lakshmanan V, Das AK, Mendiratta SK, Anjaneyulu AS. Physico-chemical and functional quality of buffalo head meat and heart meat. American Journal of Food Technology. 2008;3(2):134-40.
14. Selvan P, Mendiratta SK, Porteen K, Bhilegaonkar KN. Studies on effect of sodium hypochlorite on microbial, sensory and physiochemical characteristics of buffalo offal. American Journal of Food Technology. 2007; 2: 366-76.
15. Abou-Arab AA, Abu-Salem FM. Nutritional quality of Jatropha curcas seeds and effect of nutritional quality of Jatropha curcas seeds and effect of some physical and chemical treatments on their antinutritional factors. African Journal of Food Science. 2010; 4(3):93-103.
16. Warriss PD. The effects of live animal handling on carcass and meat quality. Meat science: an introductory text. 2000:131-55.
17. Devatkal S, Mendiratta SK, Kondaiah N, Sharma MC, Anjaneyulu AS. Physicochemical, functional and microbiological quality of buffalo liver. Meat science. 2004; 68(1):79-86.
18. Naqvi. S. K. M. H. Analytical study of Pakistani native red meat. Institute Of Chemistry University Of Punjab Lahore-Pakistan.1999.
19. Warriss PD, Wilkins LJ, Knowles TG. The influence of ante-mortem handling on poultry meat quality. In Poultry Science Symposium Series. 1999; 25:217-230.
20. Jama N, Muchenje V, Chimonyo M, Strydom PE, Dzama K, Raats JG. Cooking loss components of beef from Nguni, Bonsmara and Angus steers. African Journal of Agricultural Research. 2008;3(6):416-20.
21. Zhang YY, Zan LS, Wang HB, Xin YP, Adoligbe CM, Ujan JA. Effect of sex on meat quality characteristics of Qinchuan cattle. African journal of biotechnology. 2010;9(28):4504-9.
22. Cierach M, Tabaka K and Niedzwiedz J. Physical properties of culinary beef from beef and dairy cattle crossbreeds. Chair of Meat Technology and Chemistry, University of Warmia and Mazury in Olsztyn, Oczapowskiego 2010:2(10): 719.
23. Reza Gheisari H, Aminlari M, Shahram Shekarforoush S. A comparative study of the biochemical and functional properties of camel and cattle meat during frozen storage. Veterinarski arhiv. 2009; 79(1):51-68.
24. Young, OA., DA. Frost, J. West and TJ. Bragging. Analytical Method. In: Meat Science and Applications. Hui et al edition. Marcel Dekker, Inc, USA.2001. PP. 104-117.

25. Mojto J, Zaujec K, Gondeková M. Effect of age at slaughter on quality of carcass and meat in cows. Slovak Journal of Animal Science. 2009;42(1):34-7.
26. Koohmaraie M, Kent MP, Shackelford SD, Veiseth E, Wheeler TL. Meat tenderness and muscle growth: is there any relationship?. Meat science. 2002; 62(3):345-52.
27. Farfan N, Juarez D, Rossi A and Samman N. Chemical composition of Creole cattle meat. Arch. Latinoam. Nutr. 2000;50(4):400-404.
28. Hui YH, Nip WK, Rogers R, editors. Meat science and applications. CRC press; 2001 Jul 27.
29. Shirley RL, Hargrove DD, Palting F, Easley JF, Carpenter JW, Koger MA. Water, Phosphorus, Calcium, Ash and Protein of the Heart, Liver and Muscle of Hereford, Brahman and Hereford-Brahman Cross-Bred Cattle. Journal of Animal Science. 1963; 22(2):393-5.