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Assessment of chemical quality of local frozen cattle's liver

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ABSTRACT

The present study was conducted on 120 random samples of frozen local cattle livers collected from different slaughter shops and supermarkets in Qalyobia Governorate (60 sample each), for estimation of their keeping quality (pH, TBA, TVN, PV) and determination of the heavy metals residues (lead, cadmium, arsenic and copper) and their acceptability for human consumption. The results revealed that for frozen local livers collected from slaughter shops; the mean values of pH ,TVN, TBA and PV concentrations "mg/Kg" were 6.19 ± 0.01; 11.67 ± 0.54; 0.26 ± 0.03 and 0.55 ± 0.04. while those collected from supermarkets, the mean values of pH ,TVN, TBA and PV concentrations "mg/Kg" were 6.35 ± 0.02; 8.25 ± 0.41; 0.17 ± 0.02and 0.37± 0.0. The mean values of lead, cadmium, arsenic and copper, concentrations "mg/Kg" were 0.31 ± 0.02; 0.23 ± 0.02; 0.17 ± 0.01 and 3.81 ± 0.35 respectively .while frozen local liver samples collected from supermarkets; the mean values of lead ,cadmium ,arsenic and copper concentration "mg/Kg" were 0.19 ± 0.02 ; 0.14 ± 0.01; 0.10 ± 0.01and 3.65 ± 0.28, respectively . The study concluded that, frozen local cattle liver products have public health importance as the residues in them, might exceed the recommended safe permissible limits.

1. INTRODUCTION

There is a high demand of cattle's Liver in our society today, which is the most common part of meat widely used. This is because tissue is a great source of protein which provide the body with longer lasting energy to maintain cellular functions and it contains vitamins and minerals. Above all, it is cheap (Varnam, 1995) pH value plays an important role for the microbiological growth quality affecting the shelf life of meat (Hathout-Amal and Aly-Soher, 2010). While, TVN can be considered as a reliable indicative measure for the quality of various food articles specially those of animal origin. Ammonia is one of the most spoilage end products in spoiled meat which is directly responsible for spoilage odors and flavors, it is considered as an indicator for amino acid degradation by bacteria and it can be measured as total volatile basic nitrogen (Wilson, 1991).

Generally, TBA value is routinely used as determinator of lipid oxidation in meat and its products and when TBA values lies between 0.5 and 2.0 mg/Kg, the rancid flavor is initially detected in meat (Habbal, 2000). The peroxide value (PV) is a useful indicator of the extent of oxidation of lipids, fats, and oils. The oxidation of food lipids is undesirable due to off-flavors, toxins, and loss of fat-soluble vitamins.

Heavy metal toxicity could be present in different ways depending on its route of ingestion, its chemical form, dose, tissue affinity, age and sex, as well as whether exposure is acute or chronic (Johri *et al.,* 2010). The main heavy metals of concern are lead, cadmium, copper, mercury and arsenic which at even low concentrations pose serious health hazard to primary and secondary consumers due to bio magnifications (Demirezen *et al*., 2006). Therefore, the present study is to evaluate the contamination of frozen local cattle liver samples for their keeping quality (pH, TBA , TVN and PV) and determination of heavy metals (lead ,cadmium, arsenic and copper) and their availability for human consumption.

2. MATERIAL AND METHODS

2.1. *Collection of samples:*

A grand total of 120 random samples of cattle liver (frozen local) (60 of each) were collected from different slaughter shops and supermarkets in Qalyobia Governorate, Egypt. All collected samples were examined for determination of keeping quality (pH, TBA , TVN and PV) and heavy metals (lead, cadmium, arsenic and copper) levels on the basis of wet weight (mg/Kg).

2.2. Keeping Quality Tests:

2.2.1 Determination of pH

pH value was determined by using an electrical pH meter (Bye model 6020, USA) following Pearson, (2006):

2.2.2 *Determination of Total Volatile Nitrogen* (TVN) according to FAO (1980).

2.2.3 *Determination of Thiobarbituric Acid Number* (TBA) after Pikul *et al.* (1989):

TBA test which depends on determination of malonaldehyde (MD) as an end product of lipid peroxidation. The extent of oxidative rancidity is normally

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reported as TBA number or values and expressed as milligrams of malonaldehyde equivalents per kilogram of the samples.

2.2.4. Determination of Peroxide Value (PV).

2.3. *Determination of heavy metals*
Heavy metal residue was determined based on the following procedures
2.3.1. Washing procedures
Washing of equipment is an important process to avoid contamination with the analyzed element which followed the procedures of AOAC, (2006).

2.3.2. Digestion technique
Accurately, 1 g of each sample was digested by 10 ml of digestion mixture (60 ml Nitric acid "65%" and 40ml Perchloric acid "65 %") in screw capped tube after maceration by sharp scalpel following Tsoumboris and Papodoulou, (1994):

2.3.3. Preparation of blank and standard solutions
According to Shibamoto and Bjeldanes, (2000) the instrumental procedures for various analyses were based on those suggested in the operator manual of the Flame Atomic Absorption Spectrophotometer (VARIAN, model AA240 FS, Australia).

2.3.4. Analysis:
The digest, blanks and standard solutions were aspirated by Atomic Absorption Spectrophotometer and analyzed for their concentrations of such elements following conditions recommended by the instrument instruction

2.3.5. Quantitative determination of heavy metals:
Absorbency of mercury, lead and cadmium was directly recorded from the digital scale and their concentrations were calculated according to the following equation= R × (D/W), Where, C= Concentration of the element (wet weight);R= Reading of digital scale of AAS;D= Dilution of the prepared sample ;W= Weight of the sample.

2.4. Statistical analysis
The obtained results were statistically evaluated by application of student t-test according to Feldman *et al*, (2003).

3. RESULTS

The obtained results in table (1) showed that the minimum and the maximum pH concentrations "mg/Kg" in the examined frozen local liver samples collected from shops ranged from5. 79 to 6.51 with a mean values of 6.19 ± 0.01. In addition, the minimum and the maximum PH concentrations "mg/Kg" in the examined samples of local liver samples collected from supermarkets were ranged from 5.92 to 6.74 , with a mean values of 6.35 ± 0.02 .
The obtained results in table (2) with the minimum and the maximum TVN concentrations "mg/Kg" in the examined frozen local liver samples collected from shops were ranged from 7.47 to 14.96 with a mean values of 11.67 ± 0.54 . In addition, the minimum and the maximum TVN concentrations "mg/Kg" in the examined samples of frozen local liver samples collected from supermarkets were ranged from 4.80 to 10.73 with a mean values of 8.25 ± 0.41.

Table 1 Statistical analytical results of pH in the examined samples of frozen local livers (n=60).

Locality	Frozen local liver		
	Min	Max	Mean ± S.E*
Shops	5.79	6.51	6.19 ± 0.01 [a]
Supermarkets	5.92	6.74	6.35 ± 0.02 [b]

S.E* = standard error of mean. N.B. Means with different superscripts were significantly different (P<0.01)

Table 2 Statistical analytical results of Total Volatile Nitrogen (TVN) "mg %" in the examined samples of frozen local livers (n=60).

Locality	Frozen local liver		
	Min	Max	Mean ± S.E*
Shops	7.47	14.96	11.67 ± 0.54 [a]
Supermarkets	4.80	10.73	8.25 ± 0.41 [b]

Table (3) revealed the minimum and the maximum TBA concentrations "mg/Kg" in the examined frozen local liver samples collected from shops were ranged from 0.18 to 0.35 with a mean values of 0.26 ± 0.03 . In addition, the minimum and the maximum TBA concentrations "mg/Kg" in the examined samples of frozen local liver samples collected from supermarkets were ranged from 0.09 to 0.24 with a mean value of 0.17 ± 0.02.
The obtained results in Table (4) present the minimum and the maximum PV concentrations "mg/Kg" in the examined frozen local liver samples collected from shops which ranged from 0.34 to 0.78 with a mean values of 0.55 ± 0.04. In addition, the minimum and the maximum PV concentrations "mg/Kg" in the examined samples of frozen local liver samples collected from supermarkets were ranged from 0.22 to 0.59 with a mean values of 0.37 ± 0.02

Table 3 Statistical analytical results of Thiobarbituric acid value (TBA) "mg/Kg" in the examined samples of local and imported livers (n=60).

Locality	Frozen local liver		
	Min	Max	Mean ± S.E*
Shops	0.18	0.35	0.26 ± 0.03 [a]
Supermarkets	0.09	0.24	0.17 ± 0.02 [b]

Table 4 Statistical analytical results of Peroxide value (PV) "meqO2/Kg" in the examined samples of frozen local livers (n=60).

Locality	Frozen local liver		
	Min	Max	Mean ± S.E*
Shops	0.34	0.78	0.55 ± 0.04 [a]
Supermarkets	0.22	0.59	0.37 ± 0.02 [b]

The minimum and the maximum lead concentrations "mg/Kg" in the examined frozen local liver samples collected from shops which ranged from 0.14 to 0.57 with a mean values of 0.31 ± 0.02 (Table 5). Besides, the minimum and the maximum lead concentrations "mg/Kg" in the examined samples of frozen local liver samples collected from supermarkets ranged from 0.06 to 0.51 with a mean values of 0.19 ± 0.02. The minimum and the maximum cadmium concentrations "mg/Kg" in the examined frozen local liver samples collected from shops ranged from 0.08 to 0.52 with a mean values of 0.23 ± 0.02. The minimum and the maximum cadmium concentrations "mg/Kg" in the examined samples of frozen local liver samples collected from supermarkets ranged from 0.08 to 0.52 with a mean values of 0.23 ± 0.02 (Table 6).

Table 5 Statistical analytical results of lead levels "mg/Kg" in the examined samples of frozen local livers (n=60)

Locality	Frozen local liver		
	Min	Max	Mean ± S.E*
Shops	0.14	0.57	0.31 ± 0.02 [a]
Supermarkets	0.06	0.51	0.19 ± 0.02 [b]

Table 6 Statistical analytical results of cadmium levels "mg/Kg" in the examined samples of frozen local livers (n=30).

Locality	Frozen local liver		
	Min	Max	Mean ± S.E*
Shops	0.08	0.52	0.23 ± 0.02 [a]
Supermarkets	0.03	0.29	0.14 ± 0.01 [b]

The results in table (7) declared that the minimum and the maximum copper concentrations "mg/Kg" in the examined frozen local liver samples collected from shops ranged from 2.95 to 4.7 with a mean value of 3.81 ± 0.35. In addition, the minimum and the maximum cadmium concentrations "mg/Kg" in the examined samples of frozen local liver samples collected from supermarkets ranged from 2.68 to 4.53 with a mean values of 3.65 ± 0.28 .

The results in table (8) declared that the minimum and the maximum Arsenic concentrations "mg/Kg" in the examined frozen local liver samples collected from shops were ranged from 0.07 to 0.32 with a mean value of 0.17 ± 0.01. In addition, the minimum and the maximum Arsenic concentrations "mg/Kg" in the examined samples of frozen local liver samples collected from supermarkets ranged from 0.01 to 0.21 a mean value of 0.10 ± 0.01.

Table 7 Statistical analytical results of copper levels "mg/Kg" in the examined samples of frozen local livers (n=30).

Locality	Frozen local liver		
	Min	Max	Mean ± S.E*
Shops	2.95	4.77	3.81 ± 0.35 [a]
Supermarkets	2.68	4.53	3.65 ± 0.28 [b]

Table 8 Statistical analytical results of arsenic levels "mg/Kg" in the examined samples of frozen local livers (n=30)

Locality	Frozen local liver		
	Min	Max	Mean ± S.E*
Shops	0.07	0.32	0.17 ± 0.01 [a]
Supermarkets	0.01	0.21	0.10 ± 0.01 [b]

4. DISCUSSION

Regarding the results recorded in table (1), pH mean values in the examined samples and according to the safe permissible limit stipulated by ES (2005) for pH in red meat(5.6 - 6.2) and edible offal (6 - 6.8), it was indicated that all the examined samples of meat and edible offal were in accordance with this limit. The obtained results were nearly similar to those reported by Immonen et al. (2000). While, higher results were obtained by El-Shamy (2011) in the examined liver samples (6.96 ± 0.09).

It is evident from the results recorded in table (3) that TVN mean values showed that all the examined samples of meat and edible offal were accepted according to the safe permissible limit recommended by ES (2005) for TVN in red meat (should not exceed 20 mg/100 gm) and edible offal (should not exceed 30 mg/100 gm). TVN value was more useful for assessing the degree of meat deterioration than for evaluate the results of TVN were nearly similar to (Saleh- El Shafay, 2013), who recorded that result of TVN in examined liver sample were13.06 ±0.04 .

Results achieved in table (5) revealed that TBA mean values (mg malonaldehyde/kg of sample) in the examined meat and edible offal were accepted based on their TBA content according to ES (2005) which stated that the maximum permissible limit for TBA in meat and edible offal should not exceed 0.9 mg malonaldehyde/kg of sample. TBA is a good indicator of the quality of meat and widely used indicator for the assessment of degree of lipid oxidation (Raharjo and Sofos, 1993). Results of TBA were nearly similar to (Saleh- El Shafay.2013)**,** who recorded that result of TBA in examined liver sample were 0.16 ± 0.01.

Due to lipid oxidation and bacterial growth which are the main factors that determine food quality loss and shelf life reduction; Lipid oxidation leads to the degradation of lipids and proteins which, in turn, contribute to the reduction in nutritional quality as well as deterioration in flavor, color and texture of displayed meat (Aguirrezábal et al., 2000).

The peroxide value is a useful indicator of the extent of oxidation of lipids, fats, and oils. The oxidation of food lipids is undesirable due to off-flavors, toxins, and loss of fat-soluble vitamins. Therefore, the product be palatable and fit for human consumption.it is difficult to provide specific guideline relating peroxide value to rancidity. High peroxide value is a definite indication of rancid fat, but moderate value may be a result of depletion of peroxide after reaching high concentration while, low peroxide value may also be obtained for any extremely rancid product, again because the peroxide initially formed have all undergone further oxidation reaction (Levermore, 2004; Gotoh and Wada, 2006)

Heavy metals are considered as the main toxic byproducts causing serious health hazards to human and animal populations through progressive irreversible accumulation in their bodies because of repeated consumption of small amounts of these elements (Chitmanat and Traichaiyaporn, 2010). Thus, it is of great importance to determine the concentrations of heavy metals in edible offal, which became an essential part of human fast food. The public health concern over food safety is now increasing as the communications improve and the public become better educated about health hazard caused by environment contamination. Heavy metals can interfere with the functions of enzymes and are responsible for many diseases, especially cardiovascular, renal, and even bone disorders. Besides, some metals are considered as being carcinogenic, mutagenic and teratogenic in experimental animals (Abou-Arab, 2001).

The study concluded that frozen local cattle livers products have public health importance as the residues in them, might be exceeded the recommended safe permissible limits. Lower results were reported by Holm (1980) who recorded a concentration of 0.21 mg/kg, While, higher results were obtained by Milhaud and Mehennaoui (1988) who recorded a value of 3.6 mg/kg. The obtained result of Lead (Pb) were nearly similar to those reported by Hassan (1998), who recorded the values as 0.92 mg/kg and Farag (2002), who recorded the concentration of (Pb) in liver as 0.91 mg/kg.

The obtained result of Cadmium (Cd) were nearly similar to those reported by Kacmar et al. (1981), who recorded a concentration of in liver as 0.33 mg/kg Lower results were reported by Salmi and Hirn (1984), who recorded a concentration of 0.07 mg/kg. While, higher results were obtained by Yousef et al.,(1988)who recorded a value of 1.03mg/kg.

The Copper (Cu) values recorded revealed that higher results were obtained by Falandysz et al. (1991), who recorded a value of 18mg/kg.

The obtained results of Arsenic (As) values revealed that higher results were obtained by Khalfalla (2011), who recorded a value of 4.64mg/kg.

Finally, the present study proved that frozen local cattle liver products have public health importance as the residues in them, might be exceeded the recommended safe permissible limits stipulated by Food Stuffs Cosmetics and Disinfectant Act (2007) and Egyptian Organization for Standardization (EOS, 2010) and must be controlled to prevent or minimize the toxic residues and improve the sanitary status of frozen local and imported livers.

5. CONCULSION

Liver tends to be the preferred organ for accumulation of heavy metals and, from the findings of this study, for people who must eat the frozen local liver of cow, they must consider the risk to trace metal build up in their bodies. There is also a need for continuous monitoring of these and other metals in cow in the interest of humans who consume them.

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