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Nutrition Value, Physiochemical Property and Microbial Evolution of Yoghurt (MAST) in Halabja City, Kurdistan, Iraq

Awin Ibrahim Mohammed[1]; Pari Hama Sharef Mahmud[2]*; Dyar Hassan Hama Kawani[2] and Kocher Jamal Ibrahim[2]

[1] Food Science & Quality Control Department, Technical College of Applied Science, Sulaimani Polytechnic University, Kurdistan Region, Iraq

[2] Food Science & Quality Control Department, College of Agricultural Engineering Science, University of Sulaimani Kurdistan Region, Iraq

ABSTRACT

This study was carried out during 2017-2020 in the food science and human nutrition department college of agricultural sciences University of Hlabja, were studied different physiochemical properties of locally yogurt in Halabja city. During the study cow milk was used from different area. Microbial evolution was studied too, this product has an important properties and special aroma and flavour, it is generally conceders as a main meal in breakfast for Iraqi family. This product is deference from area to another according to type of animal, its breed and feeding of animals. Yogurt product were divided in too 10 categories accprding to the different area .There are many factors affecting this product. this study content physical properties including (viscosity, hardness, pH and texture determination). In other hands this study was mentioned to the chemical properties of yogurt including % of (Moisture, ash, fat, protein and water holding capacity). The data was analyzed according to XLSAT test. Microbial evolution was carried out for three types of microorganism which were *Streptococcus spp.* , *Lactobacillus spp,* and *Yeasts* for all categories .In this current study illustrated that among all categories category 8 has a standard properties in flavour, aroma, portion ,total solid , moisture and hardness. In microbial evolution there were not any contamination with these species of bacteria and yeasts.

***Keywords*:** Nutrition Value, Physiochemical Property, Microbial Evolution, Yoghurt, MAST

INTRODUCTION

The process of yogurt making is still a complex process, which combines both art and science together. The microorganisms of the yogurt starter cultures play an important role during the production of yogurt, especially in the development of acid and flavor. However, in order to understand the principles of yogurt making, it will be useful to describe separately the various stages of manufacture and their consequent effects on the quality of yogurt, the original production of fermented milk products derived from the need to prolong the shelf-life of milk instead of being disposed (Sfakianakis 2014)

Milk is one of the most valuable and natural food materials. It is a fluid rich in fat and protein produced by mammals to feed their newly born before they are able to eat other types of food. According to evidence, animal milk has been used as a food material since around 5000 BC (McGee 2007)

Fermentation is a process used to produce new food products depending on the action of enzymes, which break down organic substances into smaller compounds. Because of this process, new kinds of products are formed, which are more healthy, flavored and storable for a longer time (Tamime AY 2007). Yogurt is one type of fermented dairy products which is consumed widely in Iraq more than any other type of dairy products and it is a product result from heat treated milk by the action of starter which consists of *Streptococcus salivarius ssp. thermophilus* and *Lactobacillus delbrueckii ssp. Bulgaricus* (Clark S 2014)

The raw material for yoghurt fermentation is generally cow's milk or the milk from other mammals such as goat, sheep, camel, buffalo, etc. In cow's milk the milk solids non-fat level (MNSF) is 8.5-9% of which around 4.5% lactose, 3.4% protein and 0.7% minerals, and each of these components are vital for the production of a satisfactory yoghurt (Tamime AY 2007).

Similar to milk, Yoghurt, provide the human body with different types of nutrients, like proteins, minerals and vitamins .Beside that yoghurt can consume by people suffering from lactose intolerance (Tamime AY 2007). Minerals are essential for human body activities. The level of different kinds of elements in milk and other dairy products is depending on the biological, environmental and nutritional status of animals. Furthermore, technological treatments, geographical localization and the quality of feed material are very important for the level of minor and trace elements in dairy products (Ibrahim K J. 2018) (McSweeney 2009).

In Kurdistan, yoghurt is called Mast (Ibrahim K J 2018) (NP 2017), and considered the most popular fermented dairy product which produced from cow milk or a mixture of sheep and goat milk using the traditional method (Ibrahim K J 2018)

MATERIALS AND METHODS

Collection of yogurt samples

Thirty samples of yoghurt were collected from 10 different markets in Halabja governorate, Kurdistan region, Iraq from the period of June 2021(three samples from each grocery). Samples are taken in a way that demonstrates the full production of yogurt in the city.

* **Corresponding author.**
E-mail address: pari.hamasharef@univsul.edu.iq
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The samples were transported directly to lab and freeze dryer weight of sample for mineral determination by inductively coupled plasma mass spectrometry (ICP-MS)

Yogurt-manufacture

In the laboratory, a yogurt was manufactured by using pure standard starter culture (*Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus salivarious* subsp *thermophilus*.). that obtained from local (home) method using in Kurdish traditional method, by heating the cow`s milk to boiling for 10-15 min, then cooled to body temperature (shelaten) and add inoculation with standard starter culture about 2-3 %, and incubated at room temperature with covered for about 12 hours. In addition, add inoculation with the last previous product as a starter culture around 2-3 %, and incubated at room temperature with covered for about 12 hours for stay at a temperature like an incubator (Mahmood KT 2018).

- **Milk fat** in the samples was determine by Gerber method according to British Standard Institution.
- **Moisture content**, the moisture content in milk and yoghurt samples were determined using drying methods (AOAC 2000).
- **Ash determination**
- Ash concentration in milk was estimated using the method given in AOAC (AOAC 2000).
- **Protein content**
- The nitrogen content in milk sample was estimated by Kjeldahl's method (AOAC 2000). The protein content in milk was estimated by multiplying the percent nitrogen with 6.38.
- **Yoghurt samples hydrolysis**

Yoghurt samples were hydrolyzed as described by (Bizzi CA 2011) as fellow : 0.4 g of yoghurt samples were weighed in microwave digestion vessels followed by adding 3ml nitric acid (HNO3 Trace analysis grade >68%), 2 ml of Hydrogen peroxide (H2O2, Trace analysis grade, 30) and 3 ml of Mili-Q water.The resulting mixture were digested for 45 minutes using microwave (1500W, 10 min ramp time, 20 min holding time 140°C, 15 min cooling time 55°C). After digestion process completed, 7ml of Mili-Q water was added to reach 15 ml of digest solution volume (Ibrahim K J. 2018).

- **Element analysis**

The Multi element analysis was carried out using Inductively coupled plasma mass spectrometry (ICP-MS) system (Model iCAPQ; Thermo Scientific, Bremen, Germany) equipped with auto sampler (Cetac ASX-520) at the University of Nottingham (UK). The 5 ppb of Ge, Re and Ir in 4% methanol and 2%Nitric acid solution used as an internal standard and all multi elements standards (SCP Science manufacturer; USA, Major elements 10, 20, 30 ppm and Minor elements 20,40,100 ppb) applied as an external standards (Ibrahim K J. 2018) (Khan 2014).

- **Statistical analysis**

The data were statistical analysis according to the method of analysis of variance as a general test. Factorial experiment with three replications was used by XLSAT program ver. 7.5.2 and conducted using Complex Randomized Design (CRD). All possible comparisons among the means were carried out by using (Dunkin) test at the significant level of 0.05 after they show their significant in the general test

- **pH and titratable acidity of yogurt samples**

The pH of milk and yoghurt was measured using electronic digital pH meter (Inolab WTW Series 720, Germany). Buffer solution of pH 4 and 7 were used to calibrate the pH meter. Milk sample was take in a beaker; pH meter electrode was immerse in the sample to determine pH. Titratable acidity of yogurt samples was measured by the method of (AOAC 2000). The titratable acidity wasexpressed as lactic acid%.

- **Viscosity determination**

The viscosity determination was based on Rawson and Marshall, (2007) [18]. Method, with some modification. The gel was broken by stirring with a glass rod (10 times *clockwise; 10* times anticlockwise). Rotational viscosity measurements were done using a Brookfield viscometer (model DV- E; Brookfield Engineering laboratories) using spindle No 7. Each measurement was made at room temperature at 100 rpm for 1 min. (Ibrahim K J 2018) (Rawson 2007)

- **Water-holding capacity determination**

Water-holding capacity (WHC) of yoghurt was determined as described by (Harte F. 2003). Briefly, 10 g of yoghurt was centrifuged at 5000xg for 10 min at 5oC. The resulting supernatant was carefully weighted to determine the amount of excluded water, WHC % = [1-(w2 / w1)] ×100[w1: weight of yoghurt used, and w2: weight of whey after centrifugation] (Ibrahim K J 2018).

- **Texture determination**

The evaluation of textural properties was conducted using a texture analyzer (CT3(4500), Brookfield engineering lab).The hardness of samples were measured and the operation conditions were an artificial plastic cylinder (20 mm in diameter) was inserted into each product to a depth of 20 mm with 5.0g trigger and speed of 1 mm/s (Ibrahim K J 2018) (Bonczar G 2002)

Total solid %

Sorting and grouping categories:

Categories	Mean	Groupings		
8	16.960	A		
1	13.990		B	
10	13.130		B	C
4	12.780		B	C
6	12.430		B	C
5	12.210		B	C
2	11.929			C
9	11.460			C
7	11.270			C
3	11.220			C

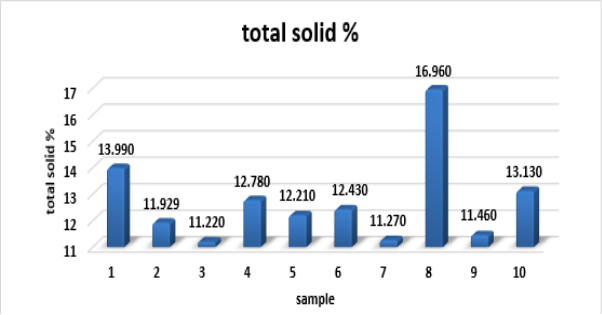

Figure. 4.1 Total solids content of local Kurdish yogurt samples in Halabja city.

In the figure 4-1 illustrated that there were significant differences among categories in total solid content among samples of yogurts, category 8 has show highest level in total solid substance, while category was show the lower level in total solid contents. Sometimes adding of the water is a vital factor in the lowering of total solid content in milks and during manufacturing of yogurts.

Moisture %

Sorting and grouping categories:				
Categories	**Mean**	**Groupings**		
3	88.780	A		
7	88.730	A		
9	88.540	A		
2	88.070	A		
5	87.790	A	B	
6	87.570	A	B	
4	87.220	A	B	
10	86.870	A	B	
1	86.010		B	
8	83.040			C

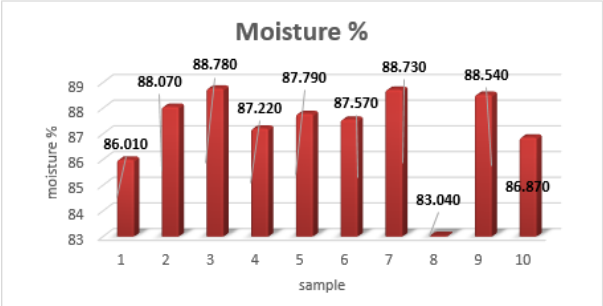

Figure. 4-2 Moisture content of local Kurdish yogurt samples in Halabja city.

Figure 4-2 explained that a significant difference among samples categories of yogurts which collected in different area in Halabja city from different locations. Category 3 was heights level content in moisture which content 88.780 %, whereas category 8 was recorded 83.40 %. There were differences among categories in contenting moisture. This differences in contenting moisture among categories due to the period of boiling of milks during manufacturing of yogurts

Protein %

Sorting and grouping categories:		
Categories	**Mean**	**Groupings**
6	3.600	A
10	3.430	A
8	3.230	A
5	3.190	A
1	3.160	A
3	3.070	A
4	3.020	A
9	2.930	A
7	2.890	A
2	2.790	A

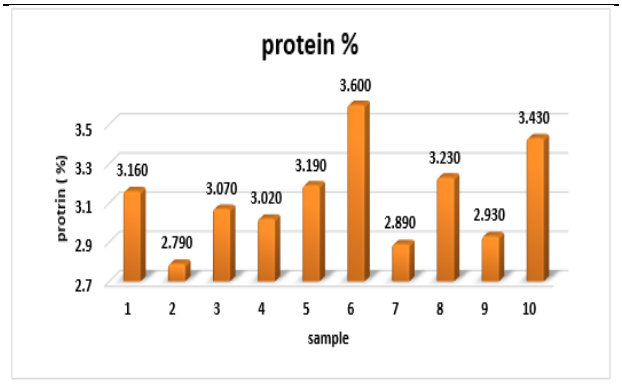

Figure. 4-3 Protein content in categories in Halabja governorate.

As shown in figure 4-3 Protein content is vary among samples of yogurts is between 2.790 -3600. There was significant differences. among samples of yogurts. Maximum value was recorded in Category 6 and minimum value was recorded in category 2. As illustrated in diagrams. This difference might be refer to animal feed and cow breeds in different area locations in Halabja governorate (Tamime and Robinson, 2000).

Fat %

Sorting and grouping categories:		
Categories	**Mean**	**Groupings**
8	4.530	A
1	4.320	A
4	4.320	A
5	4.210	A
6	3.890	A
7	3.720	A
10	3.650	A
2	3.490	A
9	3.210	A
3	3.170	A

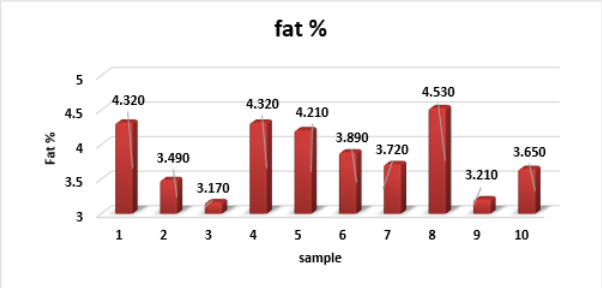

Figure. 4-4 Protein content in categories in Halabja governorate yogurt samples.

Fat is a vital factors ,independent factors limited the price of yogurts .The highest value was recorded in the category 8 and the lower value was recorded in category 3,These deference's among categories due to the animal breeds and the method of feeding among categories (Tamime and Robinson (2000) .

Ash %

Sorting and grouping categories:		
Categories	**Mean**	**Groupings**
8	0.995	A
1	0.995	A
5	0.994	A
10	0.993	A
4	0.993	A
3	0.993	A
6	0.993	A
9	0.992	A
7	0.992	A
2	0.990	A

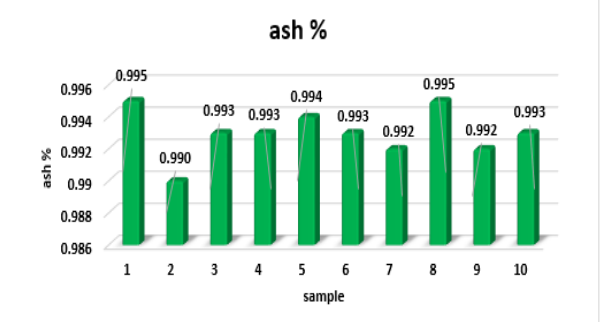

Figure. 4-5 Protein content in categories in Halabja governorate yogurt samples.

There was not significant differences in Ash content among sample categories in cooperation among

categories shows that the highest value was recorded in the category 8 and the lowest value was shows in the category 2 , These ratios were higher than the other explained by Warakaulle et al. (2016) as 0.72% and 0.73%, respectively.

Water holding capacity %

Sorting and grouping categories:

Categories	Mean	Groupings
8	58.500	A
1	49.100	B
4	47.100	C
10	44.000	D
5	44.000	D
3	43.500	D
6	40.800	E
7	39.200	E
2	37.400	F
9	36.500	F

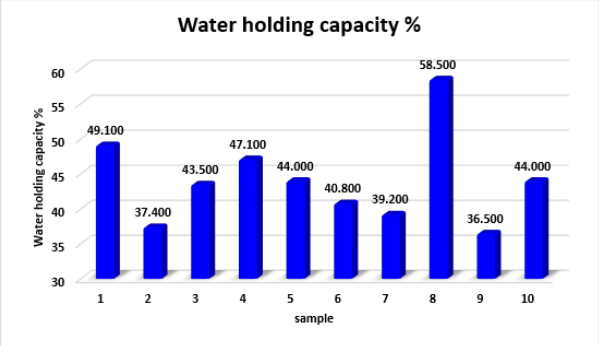

Figure. 4-6 Water holding capacity in categories

Water holding capacity is another vital factors that affected by consuming of yogurts .that in the category 8there was 58.gorie and in the category 9 was 36.5 %and other call categories has not significant differences among them

Hardness 1 (g)

Sorting and grouping categories:

Categories	Mean	Groupings
8	121.333	A
4	73.333	B
3	71.333	B C
1	69.863	B C D
10	67.667	B C D
5	65.500	B C D
2	62.167	C D
7	61.000	D
9	44.833	E
6	41.833	E

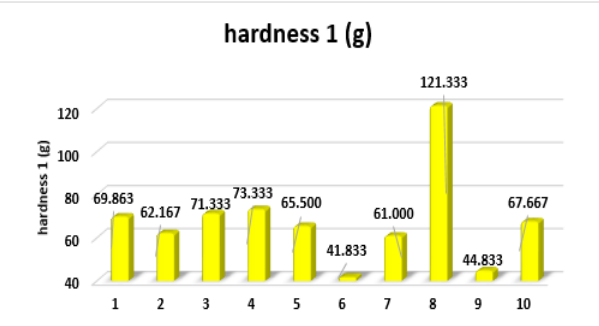

Figure. 4.7 Hardness of local Kurdish yogurt samples in Halabja governorate

As shown in the figure 4-6 there was significant differences among category 8 and other categories in another side there were not significant among the other samples or categories.

As illustrated that hardness of category 8 was 121.333 but there was in category 6 was 41. 833.Hardness is a vital factor which limited the properties of yogurts and important factors in the consuming yogurts among consumers. (Mariano *et al*,.2011)

Hardness2 g

Sorting and grouping categories:

Categories	Mean	Groupings
3	55.833	A
4	55.333	A
5	49.667	B
8	48.833	B
7	48.833	B
1	46.833	B
10	46.000	B
9	39.000	C
2	36.167	C
6	35.333	C

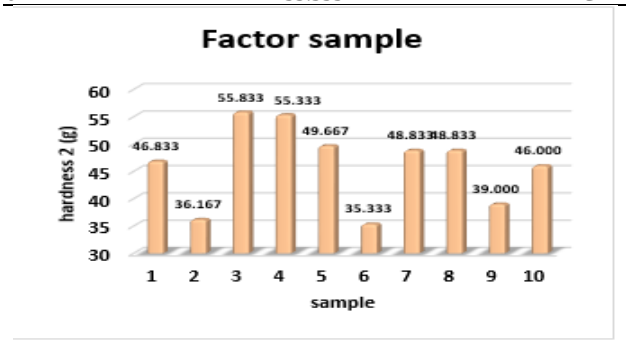

Figure 4.8 Hardness of local Kurdish yogurt samples in Halabja governorate

Ca^{+} mg/kg (ppm)P mg/kg (ppm)

Sorting and grouping categories:

Categories	Mean	Groupings
2	1694.000	A
7	1617.000	A B
6	1547.000	A B C
10	1487.000	A B C
4	1453.000	B C
5	1450.000	B C
1	1367.000	C
3	1357.000	C
8	1334.000	C
9	696.567	D

Sorting and grouping categories:

Categories	Mean	Groupings
2	1648.000	A
7	1480.000	B
4	1374.000	C
10	1313.000	D
5	1295.000	E
6	1287.000	F
8	1257.000	G
1	1201.000	H
3	1131.000	I
9	743.300	J

K mg/kg (ppm)

Sorting and grouping categories:		
Categories	**Mean**	**Groupings**
2	2821.000	A
1	2544.000	B
7	2470.000	C
10	2238.000	D
4	2225.000	E
8	2107.000	F
5	2093.000	G
3	2002.000	H
6	1857.000	I
9	1256.000	J

S mg/kg (ppm)

Sorting and grouping categories:		
Categories	**Mean**	**Groupings**
2	693.000	A
7	548.900	B
5	527.400	C
1	514.100	D
4	512.000	E
6	507.200	F
3	503.400	G
10	491.367	H
8	473.800	I
9	328.300	J

Na mg/kg (ppm)

Sorting and grouping categories:		
Categories	**Mean**	**Groupings**
2	722.200	A
7	653.700	B
6	558.400	C
5	510.400	D
1	485.300	E
10	473.600	F
3	444.000	G
8	422.100	H
4	380.100	I
9	284.400	J

Mg mg/kg (ppm)

Sorting and grouping categories:		
Categories	**Mean**	**Groupings**
7	162.900	A
2	161.500	A
6	136.200	B
8	128.400	C
1	126.100	D
5	124.300	E
4	120.600	F
3	115.500	G
10	113.300	H
9	79.870	I

Zn mg/kg (ppm)

Sorting and grouping categories:		
Categories	**Mean**	**Groupings**
2	6133.000	A
6	5319.000	B
8	5220.000	C
7	4890.000	D
10	4740.000	E
5	4601.000	F
1	4216.000	G
4	4120.000	H
3	3993.000	I
9	2518.000	J

Fe mg/kg (ppm)

Sorting and grouping categories:		
Categories	**Mean**	**Groupings**
2	123.100	A
1	94.540	B
7	78.110	C
6	71.500	D
4	44.980	E
9	44.070	E
8	36.090	F
10	30.967	G
5	26.170	H
3	19.550	I

Microbial content among categories

Categories	*Streptococcus spp.* Cfu g^{-1}	*Lactobacillus spp.* Cfu g^{-1}	Yeasts Nog^{-1}
8	114X10^6	112X10^6	50X10^4
3	128X10^6	132X10^6	60X10^4
5	132X10^6	145X10^6	64X10^4
7	152X10^6	150X10^6	70X10^4
10	157X10^6	158X10^6	72X10^4
4	168X10^6	164X10^6	75X10^4
2	172X106	167X10^6	78X10^4
1	176X10^6	172X10^6	80X10^4
9	177X10^6	179X10^6	82X10^4
6	186X10^6	180X10^6	87X10^4

In the study of microbial content among categories, there were significant differences among categories ($P \leq 0.05$) in viable numbers of *streptococcus spp*.

among categories, this scores are due to the competition of microorganisms

The viability of these number of yeasts were due to the poor hygienic during manufacturing and processing of yogurts in different stages. Because heat treatment in the manufacturing of yogurts were destroyed all types of microorganism pathogenic and non-pathogenic bacteria. Finally, contamination of these spp. might be after manufacturing, processing and packaging. all numbers of microorganisms were in the permeable ranges (Fernandez *et al*, 2000). (Frank *et al*,.2004)

CONCLUSION

The yogurt which produced from cow milk is differ from one place to another, this due to the physiochemical properties according to manufacturing method, the origin of milk and the period of fermentation and the starter which added in manufacturing of it . The different properties observed there in the comparison among all categories there were a lot variation of physiochemical properties due to the method of manufacturing of the yogurt, it was affecting by the incubation period and the source of milk according to breed of cow and them feeding, method of the storage and the temperature of the storage. The treatable acidity was higher than the normal because it was affected by the storage period and this was the cause of whey separation.

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دراسة القيمة الغذائية و الصفات الفيزيو كيمياوية و التقييم الميكروبي لليوكرت اللبن الكردي (ماست) في مدينة الحلبجة ، إقليم كردستان ، العراق .

ئه وين ابراهيم محمد [1]، به ري حمة شريف محمود [2]، د يار حسن حمة كاواني [2] و كوجر جمال ابراهيم [2]

[1] قسم علوم الأغذية والسيطرة النوعية ، كلية التقنية للعلوم التطبيقية ، جامعة السليمانية التقنية ، إقليم كوردستان العراق

[2] قسم علوم الأغذية والسيطرة النوعية ، كلية علوم الهندسة الزراعية ، جامعة السليمانية ، إقليم كوردستان العراق

اجريت هذه الدراسة في كلية الزراعة \جامعة السلبمانية \قسم العلوم الاغذية و السيطرة النوعية بهدف الكشف عن القيمة الغذائية ,الصفات الفيزيو الكيمباوية للبن الكردي المعروف ب (ماست) و التقيم المايكروبي له و المسمى في بعض المناطق الاخرى بال (يوكرت),وهذا المنتج يتميز بالصفات المميزة و النكهة الخاصة و يعتبر المادة الرئيسية قي الفطور للفرد العراقي و يختلف من المنطقة الى الاخرى حسب مصدر الحليب المنتج و نوع الحيوان و السلالة و التغذية الحيوان الحلوبة و هنالك عدة العوامل الاخرى يتاثر ايظا على نوعية و كمية الحليب المنتج . في هذه الدراسة ركزت على الحليب المنتج من قبل الابقار المحلي في منظقة الحلبجة \كردستان \العراق درست الصفات الفيزباوية حيث شملت (اللزوجة,الصلابة ,وبعض الصفات الاخرى .و التحليل الكيمياوي للفئات العشرة حيث شملت نسبة البروتين,الدهن ,الرطوبة و الرماد ,و واتظحت بان الفئة الثامنة تميزت بكل الصفات الجيدة و القباسية مقارنة بالفئات الاخرى .و اجريت التقيم المايكروبي للفئات العشرة لبلملوثات المايكروبية درست Yeasts *Streptococcus spp.* و *Lactobacillus spp* و اتضحت بان لا يوجد اي تاثيرللملوثات. المايكروبية و كلها حسب المستوى المسموح به. .