Sudan University of Science and Technology

College of Veterinary Medicine

Studies on Effects of Age, Stage of Lactation and Production of the cow's on Milk Composition

دراسة تاثير العمر ، مرحلة الإدرار وانتاجية الحليب على التركيب الكيميائي للحليب

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الاية

قال تعالى:

﴿وأن لكم في الانعام لعبرةً نسقيكم مما في بطونه من بين فرث ودم لبنا خالصا سائغا للشاربين﴾

صدق الله العظيم

النحل الايه (66)

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DEDICATION

To our fathers, mothers, brothers and sisters

T0 all our friends and all people who supported us during this study

With great respect

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We thank our Allah who gave us the strength and patience to conduct and finish this work.

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ABSTRACT

This is an analytical study undertaken to investigate the effect of age, stage of lactation and production level on the chemical composition of milk. It was conducted at Sudan University Farm College of Veterinary Medicine during March and April 2018 .19 mature healthy non pregnant lactating cows were used .They were grouped according to their age (>6), (6-8) and (8-10) year. According to their stage of lactation they were grouped into early stage middle stage and late stage of lactation and according to the milk production level into low production (6-8), middle production (8-10) and high production level (10-12) pound.

The milk samples were collected in the evening in sterile glass tubes and then kept in ice box and transferred immediately to the dairy laboratory for analysis by a lactoscan milk analyser (40-9305)to determine their moisture, total solid ,solid not fat, fat, protein, lactose, ash, Ca, P contents and density.

The collected data were analysed by ANOVA test using Statistical Package for Social Science (SPSS16.0).

The result showed that the age of cows has a significance effect on **Ca**, the highest **Ca** level (12.2±0.4) mg/100ml by age (6-8) year, then (12.1±0.3) mg/100ml by age (8-10) year and the lowest **Ca** level (11.4± 0.8) mg/100ml b yage (>6) year.

The age also affected significantly **P** level, the highest **P** level (6.6±0.4) mg/100ml by age (6-8) year, then (6.4±0.3) mg/100ml by age (8-10) year and the lowest **P** level (6.2±0.3) mg/100ml by age (>6) year. The highest **fat** level (3.7±0.2) % in (>6) year. And the middle **fat** level by (8-10) year and the lowest level (3.4±0.1) % by middle age (6-8) year.

The stage of lactation did not affect milk production, density chemical composition.

The production level has significant effect on Ca, the highest **Ca** level (12.3±0.4) mg/100ml in middle production (8-10), and the lower **Ca** level (11.7±0.2) mg/100ml in highest production and the middle Ca level in between them.

Key Words: Dairy cattle, stage of lactation, milk composition.

الملخــص

هذه دراسة تحليلية اجريت في مزرعة جامعة السودان للعلوم والتكنلوجيا لمعرفة تاثير مرحلة الإدرار و العمر وانتاجية الحليب على التركيب الكيميائي للحليب .

تم اجراء هذه الدراسة خلال الفترة من مارس حتى ابريل 2018.

اختيرت 19 من الابقار في مراحل مختلفة من مراحل الادرار وقسمت الى ثلاثة مراحل وهي مرحلة مبكرة ومتوسطة ومتاخرة ، اعمار تلك الابقار اختيرت من السجلات .

تم جمع عينات اللبن في انابيب زجاجية معقمة من الحلبة المسائية وحفظت في ثلج وارسلت فورا الى المختبر لتحليلها بواسطة محلل اللبن ليحدد اجمالي الدهون ، الجوامد اللادهنية، البروتين ، اللاكتوز والرماد والكالسيوم والفسفور.

تم تحليل البيانات التي تم جمعها عن طريق اختبار (ANOVA) باستخدام الحزمة الإحصائية للعلوم الاجتماعية (SPSS 16.0).

كان لعمر الأبقار تأثير معنويا على الكالسيوم ، و اعلى مستوى للكالسيوم (12.2 ± 0.4) في عمر (6-8) ، ثم (12.1 ± 0.3) في عمر (8-10) وأقل مستوى للكالسيوم (11.4 ±) 0.8) في عمر (4-6) سنوات.

وكان للعمر أيضًا تاثيرا معنويا على مستوى P ، وأعلى مستوى P (6.6 ± 0.4) في العمر (6-8) ، ثم (6.4 ± 0.3) في العمر (8-10) وأقل مستوى P (6.2 ± 0.3) في العمر (4 -6). أعلى مستوى للدهون (3.7 ± 0.2) في (6<) ومستوى الدهون المتوسطة على (8-10) والمستوى الأدنى (3.4 ± 0.1) في منتصف العمر (6-8).

لم تؤثر مرحلة الرضاعة على إنتاج الحليب ، التركيب الكيميائي للكثافة. نطاق الرطوبة (85-97) ، الصلبة الإجمالية (11-15) ، الصلبة لا الدهون (5.8-9.4) ، الدهون (3.3-4) ، البروتين (2.1-3.2) ، اللاكتوز (0.67-5.4) ، الرماد (0.5-0.9)، Ca(10.3-12.9)، P (5.6-7.1)، الكثافة (17.5-37.3)، الانتاج (3.5-11.6).

مستوى الإنتاج له تأثير معنوي على Ca ، وهو أعلى مستوى Ca (12.3 ± 0.4) في الإنتاج المتوسط (8-10) ، وانخفض مستوى الكالسيوم (11.7 ± 0.2) في أعلى مستوى للإنتاج ومستوى Ca الأوسط بينهما.

Introduction

The dairy cows are the cow's breed with ability to produce large quantities of milk from which milk products are derived. And the milk only produced after they given birth, a cow must give birth to calf every year to keep producing milk. And the dairy cow plays a significant role in Sudanese economy providing livelihood for large sectors of population, enriching people diets with a high source of protein, vitamins and minerals.

Khartoum state holds the lower number of cattle compared with other state but it represents the major modernized dairy production center specialized in commercial milk production. The following table shows the distribution of the dairy farms and milk production in Khartoum State

Distribution of dairy farms and milk production in Khartoum State

The number	loctation	Number of cowshed	Production liter/day	Number of cows
1	Gabal awlya	706	338400	25610
2	East nile	1183	1902600	39164
3	Umbada	300	396000	8200
4	Karary	-	-	1400
5	Bahry	43	4672	13617
6	Omdurman	-	-	6072
Total		2232	2641672	94063

The most important effects in milk production variation due to species, individual variation is responsible for some greatest variation in milk composition, the breed, the stage of lactation, the environmental factors stage of milking, age of the cow, starvation, management and husbandry practice, diseases of udder and mastitis, effect of food and other variation.

Chapter One

Literature review

1-1 Milk:

Considerable resource of products whose composition varies. Four components are dominant in quantitative terms: water, fat, protein and lactose; while the minor components are minerals, vitamins, enzymes, and dissolved gases. In general, cow milk is less rich in lactose, fat content and protein. On other hand, the mineral content is similar. (Mourad, 2014)

milk is heterogeneous colloidal product in which fat and protein are dispersed in water and other substance like sugar, minerals and held in solution from where the water is dispersion medium for soluble consistent. (Herrington 2000)

1-2 Composition and characteristic of milk:

Milk is a white, opaque liquid, it can be slightly yellowish especially during the summer.

The milk natural secretion with very complex the constituents present in milk are broadly categories in following two groups:

Major constituent: Water, fats, protein, lactose and mineral and minor constituent: phospholipid, cholesterol, pigment, vitamin and enzyme. Milk fat, casein, lactose is

called as true consistent. The fat and solids not fat (constituents other than water) are called total milk solid

1-3 Physical properties:

1-3-1 Specific gravity:

The milk specific gravity is higher than water.

1-3-2 Density:

The density of milk and milk product is used for converting volume into mass.

1-3-3 Viscosity:

It is important in determining the rare of creaming.

1-3-4 Refractive index:

The refractive index of milk is an optical property and ranges from 1.3440 to 1.3485 milk appear turbid and opaque owing to light scatting.

1-3-5 Surface tension:

It is surface activity is related to proteins, fat, phospholipid and free fatty acid.

1-3-6 Freezing point:

It mainly used to determine added water but it can also be used to determine lactose content in milk.

1-3-7 Boiling point:

The boiling point of milk is 100.17c.

1-3-8 Acidity and PH:

Freshly drown milk has a PH value in the range 6.5 to 6.7

1-3-9 Heat stability of milk:

Stability of milk system in relation to processing temperature required for the manufacture of certain produce is a very important characteristic in the processing of milk. (Smith, 2000)

1-4 Chemical properties of milk:

Milk is a true aqueous solution of lactose salts and few other minor compound.

1-4-1 Water:

Water forms the largest fraction of milk from 83.87%, depending upon the species breed (Smith, 2000)

1-4-2 Fat:

the most variable fraction in milk, itis content varies from breed to breeds milk fats is present as a suspension of small globules of varying diameter, the composition of fat varies with the feed plan, nutrition, stage of lactation, breed and species, milk is quite bland in taste impart smoothness and palatability to fat containing dairy products. (Smith, 2000)

1-4-3 Milk proteins:

Amino acids form the building blocks of proteins they contain both a weak basic amino group and a weak acidic carboxyl group both connected to hydrocarbon chain,

they are bind together in a random organ by the peptide linkage to form the poly peptide chain.

1-4-3-1 The casein:

Casein equal 80% of the total protein in milk.

1-4-3-2 whey proteins:

The green clear liquid that separates out of milk after precipitation of casein at PH 4.6 is called whey and the proteins contained therein are whey proteins

1-4-3-3 Non protein nitrogenous (NPN) substance:

Milk content, besides proteins, NPN substance like amino acids, creatine, uric acid. (Smit, 2000).

1-4-4 Carbohydrate:

Main carbohydrate in milk is lactose. Its concentration varies slightly in milk (4.5 to5.2g/100g). Contrary to the concentration of fat. It plays a role in fermented milk production. (Fillion, 2006).

1-4-5 Minerals:

Play important role in structural organization of casein micelles. The major salt constituent, potassium, sodium, magnesium etc., are distinguished if the content is greater than 0.1g per liter of those containing trace amounts. (Amiot *et al*., 2002)

1-4-6 Enzymes:

Are specific globular proteins produced by living cells Each enzyme has its isoelectric point and is susceptible to various denaturing agents such as pH change, temperature, ionic strength, organic solvent (Carole and Vignola, 2002)

1-4-7 Vitamins:

Levels of vitamin A and E are variable; depending on the season as there is a slight increase during the pasture season (spring-summer). They are fat-soluble, so it is found in fat and can be lost during skimming. Other vitamins are water soluble and are found in the serum. (Schrdos, 1982).

1-5 the cattle types and breed in Sudan: -

1-5-1 North zebu cattle

1-5-2 Bagarh cattle

1-5-3 kenana cattle

1-5-4 Nuba mounts cattle

1-5-5 White Nile cattle.

(Madni 1996)

1-6 Factor affecting milk composition:

Many factor influence the composition of milk, the major component of which are water, fat, lactose and mineral.

Milk composition and component yields also can be affected by genetics and environment, level of milk production, stage of lactation, disease, season, and age of cow. (Looper, 2012)

1-6-1 Management practices:

It can enhance the level of milk fat and protein concentration in milk. Feeding strategies that optimize rumen function also maximize milk production and milk component percentage and yield. (Looper, 2012)

1-6-2 Genetics and Environment:

A change in milk composition using traditional breeding techniques occurs slowly, although new technique of genetic manipulation may allow faster progress in the future yields of milk.

Fats, protein and total solids are not easily impacted by genetics heritability estimates for yield are relatively low at about 0.25. (Looper, 2012).

1-6-3 Level of production:

Yields of fat, protein nonfat solids and total solids are highly and positively correlated with milk yields, under selection program that emphasize milk yield, fat and protein yield also increase. (Looper, 2012).

1-6-4 Stage of lactation:

Concentration of milk fat ad protein is highest in early and late lactation and lowest during peak milk production through mid-lactation. Normally, an increase in milk yield is followed by decrease in the percentage of milk fat and protein, while the yields of these constituent remain unchanged or increase. (Looper, 2012)

1-6-5 Diseases:

Although other disease can affect milk composition content and distribution mastitis is predominant disease studied mastitis results in a reduction in fat and casein content and increase in whey content of milk. This change in milk protein with alteration in lactose, mineral content and milk PH result in lower cheese yields and altered manufacturing properties (Looper, 2012).

1-6-6 Season:

Milk fat and protein percentage are highest during the fall and winter and the lowest during the spring and summer. This variation is related to changes in both the type of feed available and climatic conditions.

Lush spring pasture low in fibers depress milk fat. Hot weather and high humidity decrease dry matter intake and increase feed sorting resulting in lower forage and fiber intake. (Looper, 2012).

1-6-7 Age:

While milk fat content remains relatively constant, milk protein content gradually decreases with animals advancing age. (Looper, 2012).

1-6-8 Maximizing rumen function:

Can increase milk components, there are several strategies that producer can use to enhance rumen function and resulting milk component. (Looper, 2012)

1-6-9 Feed intake

Feed provides nutrient that are precursors, either directly or indirectly, of the principle milk solids. Thus an increase in feed intake usually results in the production of greater volume of milk.

In general, the proportional increase in fat, protein and lactose yields are approximately the same as the proportional increase in milk volume. Milk composition change little.

Major factor that can affect feed intake include:

Feed bunk management (keep feed bunks clean not empty).

Feeding frequency.

Feed sequencing.

Ration moisture between 25 and 50 %

Social interaction and grouping strategy of the herds.

Abrupt ration changes.

Physical facilities.

Environment temperature.

Increase feeding frequency of lower fiber, high grain diets increase milk fat levels. (Looper, 2012)

1.7 Factor affecting the milk yield:

1-7-1 Breed:

Milk yield between breeds and within breeds. Milk yield and reproduction performance play major roles in determining the profitability of dairy herds (Syrstad, 2001)

1-7-2 Genetics:

Genetics is the studies the variation and transmission of features or traits from one generation to the next. Heredity is traits from the parents to the offspring via genetic material (Butcher *et al.,* 1962)

1-7-3 Environmental condition:

Environmental is often thought as animal physical surrounding that is light, temperature variation and other parameter that may contribute to the physical comfort of an animals (Kano, 1968)

1-7-4 Season of calving:

Recent investigation has shown that the season of the year of calving also has an important relation to the amount and richness of milk which a cow produces (Costa *et al*., 1982)

1-7-5 Age at calving:

Milk yield increase rate at an increasing rate with age up to maturity and then decrease (Suleyman *et al.,* 2005)

1-7-6 Milking frequency:

Number of daily milking is of great important in determining milk yield in dairy animals. Once daily milking of dairy cows is practiced in some countries either in

early lactation to reduce metabolic stress or in late lactation to improve quality of farming life (Davis *et al.*, 1999)

1-7-7 Stage of lactation:

Significant effect for the stage of lactation on milk yield, which great enough to have an economical value (Carneiro *et al.*, 1948)

1-7-8 Dry period:

Dairy cows are usually dried off for two months prior to next calving. The rest period is necessary to maximum milk production in subsequent lactation (Sandars, 1927)

1-7-9 Disease:

Disease affecting in milk composition, milk from mastitic cows had higher concentration of TP, NCP and Sodium, but lower concentration of fat and lactose, CP, and Potassium, than milk from healthy cow. (Auldist *et al.*, 1995)

1-7-10 Calf Gender:

The birth of heifer calf conferred 1% milk yield advantages in first lactation heifers, whilst giving birth to bull calf conferred 0.5% advantage in second lactation. Heifer calves associated with a 0.66Kg reduction in saturated fatty acid content of milk in first lactation. But there was no significant difference between the genders in second lactation. (James *et al*, 2017)

1-7-11 Feeding:

Is one of the most important factors influencing cow milk production, with negative effect in both over and under-feeding

They recommended to feed dairy cows, succulent fodder in large amounts because they are easy to digest ensuring a higher feed consumption.
Concentrated feed are necessary in dairy cow to produce larger amount of cow milk. (Cristina *et al*, 2007).

The total amount of cow milk produced on each farm is determined by the mean production capacity of each lot of dairy cow, by the number of dairy cow, by the reproduction level, by lactation level, and by mammary rest of dairy cow.
Mean production capacity of dairy cow population has direct influence on the total cow milk amount produced on a daily, or yearly basis each dairy farm. (Cristina *et al.,* 2007)

Chapter two

MATERIALS AND METHODS

2.1 Study design, Area and Date of Study:

This an analytical study aimed to investigate the effect of stage of lactation, milk yield and cows age on milk composition

The study was conducted in the Farm of Sudan University of science and technology from March to April 2018.

2.2 Animals

All the animals in the farm were selected for the study (19).

The age of the cows obtained from records. The cows were classified according to their age into three groups that is (>4), (6-8), (8-10) years. And according to the stage of lactation into three group early stage (five cows), mid lactation stage (seven cows), and late stage of lactation (seven cows).

The weekly milk production (6-8), (8-10), (10-12) Pound.

2.3 Housing and feeding system:

All the animals were housed in a high roof open sided barns which were well ventilated.

They were allowed free grazing (Abu 70) in the morning and when they return back to the farm they were offered concentrated ration and water was available all the time.

2.4 Milk collection and Analysis:

The animals were milked by hand twice a day in the morning and in the evening. Milk samples were collected in the evening in sterile glass tubes and then transferred in ice box transferred immediately to the laboratory for analysis to determine their chemical composition and density

The parameter which were determined are moisture, total solid, solid not fat, protein, Lactose, ash, Ca, P and density using a lacto scan milk analyser (Bulgaria 40-9305).

2.5 Determination of fat:

The fat content was determined according to Gerber Method (Marshal. 1993), (10) ml of sulfuric acid specific gravity (1.815 at 15.5 c˚) was measured into clean dry Gerber butyrometer tubes, and then (11) ml of milk were added carefully. Then one ml of amyl alcohol (specific gravity 0.815at 15.5 c˚) was added. The content of tubes were thoroughly mixed till no white particles were seen. The tubes were then centrifuged at (1100) revolution per minute for five minutes. The tubes were transferred to a water bath at (65 c˚) for three minutes, direct reading of fat content was recorded from the measures on the tubes.

2.6 Determination of Calcium:

Calcium was determined by atomic absorption spectrophotometer method.

One gm of milk was a shed then 10 ml HCL28 % were added. Thereafter the mixture, was placed in sand –bath for one hour, then it was filtrated in 100 ml flask and completed to 100 ml with de-ionized water thereafter, 15 ml of mixture were transferred to 25 ml volumetric flask then 10 ml $CaCL_3$ 10% solution were added to the flasks for preparation of standard curve 2,4,6,8 and 10 ml volumetric flasks, then 10 ml $CaCL_{3\ were}$ added to each flask, and all the flasks were completed to 25 ml de-ionized water. The results were obtained by using atomic absorption spectrophotometer at $420_{n\ A}$ Stand X axis and the absorbance in Y axis thereafter the sample concentration was read from the graph

Ca content calculated as follows:

$$\textbf{Ca (mg/100ml)} = \frac{\textbf{sample } \boldsymbol{concentration} \times \textbf{dilution factor}}{\textbf{sample wieght}}$$

2.8 Determination of Phosphorus:

Phosphorus was determined by atomic absorption spectrophotometer method.

One gm of milk was a shed then 10 ml HCL28 % were added. Thereafter the mixture, re was placed in sand –bath for one hour, then it was filtrated in 100 ml flask and completed to 100 ml with de-ionized water thereafter ,15 ml of mixture were transferred to 25 ml volumetric flask then 10 ml of ammonium molybdate were added to the flask .for the preparation of the standard curve 2,4,6,8and 10 ml phosphorus standard solution (50mg p m) were placed in a series of 25 ml volumetric flask , then they 10 ml of ammonium molybdate were added to each one of the flasks .then they were completed to 25ml with de –ionized water . the blank solution was prepared by diluting 10 m ammonium molybdate to 25 ml with de –ionized water, the results were obtained by using atomic absorption spectrophotometer at 440nm by which the standard curve was prepared (phosphorus concentration on the X axis and the absorbance on the Y axis) thereafter the sample concentration was read from the graph

P content calculated as follows:

$$\textbf{P (mg/100ml)} = \frac{\boldsymbol{sample\ concentrstion \times dilution\ factor}}{\boldsymbol{sample\ wieght}}$$

2-9. Statistical analysis:

Effect of the age, stage of lactation and milk production level on the milk composition was tested by Analysis of Variance (ANOVA) using SPSS (version 16). The data were presented as means ±standard deviation.

Chapter three

Results

3-1 Effect of age of cows on milk composition and production:

Table (1) shows that the age of the cows affected some of the milk component milk composition,

It has a significance effect on Ca, the highest Ca level (12.2±0.4)mg/100ml by age (6-8) year, then (12.1±0.3) by age (8-10) year mg/100ml and the lowest Ca level (11.4± 0.8) mg/100ml by age (>6) years.

The age also affect significantly P level, the highest P level (6.6±0.4)mg/100ml was registered by age (6-8) year, then (6.4±0.3)mg/100 by age (8-10) year and the lowest P level (6.2±0.3)mg/100ml by age (>6) year. The highest fat level (3.7±0.2) % by age (>6) year and the middle fat level by (8-10) and the lowest level (3.4±0.1) % by middle age (6-8) year.

3-2 Effect of stage of lactation on milk composition and production:

Table (2) shows that the stage of lactation did not affect milk production, density or chemical composition.

3-3 Effect of production level on milk composition:

Table (3) shows that the milk production level did not affect moisture, total solid, solid not fat, fat, protein, lactose, ash, mineral and density.

It has significant effect on Ca, the highest Ca level (12.3±0.4)mg/100ml in middle production (8-10) pound, and the lowest Ca level (11.7±0.2)mg/100 in highest production and the middle Ca level in between them.

The overall milk composition of all the cows irrespective of the studied factors was as follows moisture mean range(88±2.41,85-97)%, and total solid range (12±0.6, 11-15)%, solid not fat (7.6±0.6 , 5.3-9.4)%, fat (3.6±0.2 , 3.3-4)% , protein (2.8±0.3 , 2.1-3.19)%, lactose (4±0.9 , 0.67-5.4)%, ash (0.6±0.7 , 0.5-0.9)%, Ca(6.4±0.4 , 5.6-7.1)mg/100ml , P (11.7±0.8 ,10.2-12.9) and density (27±4.6 ,17.5-37.3)g/ml.

Table (1) Effect of age of the cows on milk production level and milk composition

Parameter / Age/year	Moisture %	Total solid%	Solid not fat%	Fat%	Protein%	Lactose%	Ash%	Ca mg/100ml	P mg/100ml	Density g/ml	Production/pound
> 6	89±4.7 85-97	11±1.6 11-15	7.6±0.7 6.9-8.5	3.8±1.3[a] 3.5-4	2.8±0.2 2.5-3.11	4±0.5 3.4-4.7	0.7±0.6 0.6-0.7	6.1±0.2[ab] 5.9-6.4	10.9±0.4[ab] 10.3-11.3	27.3±2.7 24.4-30.3	8.1±1.9 3.5-11.7
6-8	87.8±.89 87-89	12±1.1 11-14	7.6±1 6.1-8.7	3.4±01[ab] 3.3-3.6	2.8±0.4 2.22-3.2	3.7±1.5 0.67-4.9	0.7±0.6 0.5-0.7	6.6±0.3[a] 6.1-7.1	12.3±0.6[a] 11.8-12.9	27.±4.7 19.2-31.5	8.1±1.4 6.1-10.1
8-10	88±.81 87-89	12±0.81 11-13	7.6±1.2 5.8-9.4	3.6±0.1[b] 3.4-3.7	2.7±0.7 2.1-3.09	4±0.7 3.2-5.4	0.6±0.1 0.5-0.9	6.5±0.3[b] 5.6-6.9	12.1±0.5[b] 11.2-12.9	26.9±5.9 17.5-37.3	7.9±1 6.2-9.7
total	88±2.41 85-97	12±0.16 11-15	7.6±0.6 5.3-9.4	3.6±0.2 3.3-4	2.8±0.3 2.1-3.19	4±0.9 0.67-5.4	0.6±0.7 0.5-0.9	6.4±0.4 5.6-7.1	11.7±0.8 10.2-12.9	27±4.6 17.5-37.2	8±1.7 3.5-11.7

- a,b,ab means within the same column followed by different superscripts are significant different at p value = 0.05

Table (2) Effect of stage of lactation on milk composition and production level

Parameter / lactation stage	moisture%	Total% solid	Solidno t fat%	Fat%	Protein %	Lactose %	Ash%	Ca mg/100ml	P mg/100 ml	Density g/ml	Production/ pound
First stage	89±4.7 85-97	11±1.6 11-15	7.6±0.7 6.9-8.5	3.8±1.3 3.5-4	2.8±0.2 2.5-3.1	4±0.5 3.4-4.7	0.7±0.6 0.6-0.7	10.9±0.4 10.3-11.3	6±0.2 5.9-6.4	27.3±2.7 24.4-30.3	8.1±2.9 3.5-11.6
Second stage	87.8±.89 87-89	12±1.1 11-14	7.6±1 6.1-8.7	3.4±01 3.3-3.6	2.8±0.4 2.2-3.2	3.7±1.5 0.67-5	0.7±0.6 0.5-0.7	12.3±0.6 11.8-12.9	6.6±0.3 6.1-7.1	27.±4.7 19.2-31.5	8.1±1.4 6.1-10.1
Third stage	88±.81 87-98	12±0.81 11-13	7.6±1.2 5.8-9.4	3.6±0.1 3.4-3.7	2.7±0.7 2.1-3.1	4±0.7 3.2-5.4	0.6±0.1 0.5-0.9	12.1±0.5 11.2-12.9	6.5±0.3 5.7-6.9	26.9±5.9 17.5-37.3	7.9±1 6.2-9.7
total	88±2.41 85-97	12±0.16 11-15	7.6±0.6 5.8-9.4	3.6±0.2 3.3-4	2.8±0.3 2.1-3.2	4±0.9 0.67-5.4	0.6±0.7 0.5-0.9	11.7±0.8 10.3-12.9	6.4±0.4 5.6-7.1	27±4.6 17.5-37.3	8±1.7 3.5-11.6

Table (3) Effect of production level on milk composition

Parameter / Production /pound	Moisture%	Total% solid	Solid not fat%	Fat%	Protein%	Lactose%	Ash%	Ca mg/100ml	P mg/100ml	Density g/ml
6-8	88.6±3.6 85-97	12.9±1.5 11-15	7.5±0.8 6.9-8.5	3.6±0.2[a] 3.5-4	2.8±0.3 2.5-3.1	3.6±1.3 3.4-4.7	0.9±0.1 0.6-0.7	11.5±0.9[ab] 10.3-11.3	6.3±0.3[ab] 5.9-6.4	26.5±4 24.4-30.3
8-10	88.1±0.8 87-89	11.9±0.8 11-14	7.5±1.1 6.1-8.7	3.5±0.1[ab] 3.3-3.6	2.8±0.4 2.2-3.2	4.2±0.6 0.67-4.9	0.6±0.1 0.5-0.7	12.3±0.4[a] 11.8-12.9	6.5±0.4[a] 6.1-7.1	26.3.±4.7 19.2-31.5
10-12	87.3±0.6 87-89	12.6±0.6 11-13	7.9±1.2 5.8-9.4	3.6±0.1[b] 3.5-3.7	2.7±0.1 2.1-3.1	4.5±0.8 3.2-5.4	0.7±0.2 0.5-0.9	11.7±0.2[b] 11.2-12.9	6.4±0.5[b] 5.7-6.9	29.9±6.3 17.5-37.3
total	88.1±2.4 85-97	12.4±1.1 11-15	7.6±0.9 5.8-9.4	3.6±0.2 3.3-4	2.8±0.3 2.1-3.2	3.9±0.9 0.67-5.4	0.6±0.1 0.5-0.9	11.8±0.7 10.3-12.9	6.4±0.4 5.6-7.1	26.9±4.6 17.5-37.3

- a,b,ab means within the same Colum followed by different superscripts are significant different at p value =(0.05)

Chapter four

Discussion

This is an analytical study to investigate the effect of the cows 'age, stage of lactation and milk production on the chemical composition of milk.

The age of the cow has a significant effect on Ca, P and fat which is highest in younger cows and gradually decreased with advancing age. This variation may be due to variations in the metabolic activity of the animals which is higher in the young animals than that of the older ones.

The level of lactose, total solid and protein did not vary with the age of the animals. This finding contradicts the results of Lopper, (2012) who reported that the level of protein content in the milk typically decreased 0.10 to 0.05 unit per lactation.

Milk composition was not affected by stage of lactation.

The milk protein, fat and total solids in this study were relatively constant through all the stages of lactation, this may be due to the feeding programme being constant irrespective of the lactation stage. On the contrary to the current study is the result of Stoop *et al* (2009) in Holstein –Friesian cows. They found a decrease in the fat content with the stage of lactation and they attributed this to the cows being in a negative energy balance and different fatty acid pathways.

Mahmood and Usman (2010) found an increase in the milk fat content with the advancement of lactation which contradicts the findings of this study. This may be due to their feeding regime which contained high nitrogenous compounds. Also Kuchatik *et al*., (2017) found a significant increase in the fat content of sheep milk toward the end of lactation and they attributed this to a decrease in the milk yield with the advancement of the lactation.

The level of lactose in this study remained constant. Hassan (2007) attributed the constant lactose content to the lactose being an osmotic regulator and compensator for variation in all the other milk components. Mourad *et al.*, (2014) stated that slightly in milk as lactose cannot be easily modified by feeding and true step of a dairy race to another.

Milk production level has significant effects on milk Ca, P and fat content which is in line with the report of Looper (2010) that yields of fat, protein, solid not fat, and total solids are highly and positively correlated with milk yield.

The variations in the findings between the current work and other researchers and among different researchers may be a result of variation in the environmental conditions ,species, breeds, individual variation within a breed, genetic variation, season of calving, age at calving, calving interval, number of parity and /or management and husbandry practices.

Conclusion:

It can be concluded that the age and milk production of cow's affect milk composition. The stage of lactation does not affect milk composition most probably due to the feeding practice regime rather than stage of lactation.

Recommendation:

1- The animals should be fed in groups according to the different stages of lactation and milk yield.
2- Management and environmental condition should be considered when assessing cows' milk yield and composition.
3- More research studies should be conducted to evaluate the effect of the breed, parity number, calf gender, and mastitis on both milk composition and yield.

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