قســـــــى : الصحة العـامة والطب الـوقائى ، الصناعات الغـذائية والألبـان .
كليــــــــتى : الطب البيطـــرى - والزراعـــة - جامعــــة أســـــــــيوط .
رئيسى القسم : أ.د / علـى لطـفـــــى ، أ.د / ابراهـيم ابـوالنجـــــــا .

الثبـات الحـــرارى للبن الجـاموس المصـرى وابقـار الفـريـزيـــــــان خـــلال فـترة الحليب فـى كـل مـن الوجـهـين البحـــرى والقبلــــــى

فــوزى ابـوالخـير ، توفيـق البسـيونـى ، عفيفـــى ســـيف ، عصمـت ابراهـــيم

قيمت عـدد ٩٦ عينة لــبن جـا موســـى وبقـرى طـوال موســـم الحليب لمعـــرفة مـــدى ملائمـة اللـــبن مـــن كـــل التـوعـــين لتصـنيع المنتجـــات الـــتى تعـــرض لـدرجـــات الحـــراة العـاليـــة عنـــد تصـنيعهـــا وذلك باســـتعمـال طـريقـتى الحمـام الـزيتى عنـد ١٣٠ درجـة مئـوية وطـريقـة الكحـــول الايثلى مســـتعملا تـركـيزا مختلفـا . وقـد اتضـح مـن نتـائج البحـث ان الثبـات الحـــرارى للـــبن يختلـــف باختـــلاف النـــوع واشـــهر الحليب المختلفـــة حيـــث يصـــل أقصـــاهـا فـــى الشـــهر الثـالـث والرابـــع بالنســـبة للبن الجـــا موســـى ومـــن الشـــهر الثـالـث حـــتى الخـا مـس للـبن أبقـــار الفـريـزيـان وكـذلـك باختـــلاف أماكـــن وجـــود الحيـــوانـات.

وقـــد أظهـــر البحـــث العـــلاقـة بـين طـريقـــتى الحمـام الـزيـتى والكحـول الايثلـــى ونصـــح باستخدام الطـــريقـــة الأولـــى لســـهولتهـا كمـا نوقشـــت أهميتهـــا .

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SUITABILITY OF BUFFALOE'S AND COW'S MILK FOR PROCESSING ULTRA HIGH TEMPERATURE PRODUCTS IN EGYPT DURING LACATION PERIOD

(With 2 Tables and 4 Figures)

By

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SUMMARY

A total of 96 bulk milk samples from buffaloe's and Friesian cow's were examined throughout eight months lactation period, in Upper and Lower Egypt to evaluate suitability of such milk for preparation of ultra high temperatue products. The evaluation of heat stability of milk was done using two well known methods (Oil-bath and ethanol tests) measuring the stability of raw milk to high temperature. The reliability of both methods was also mentioned. Heat stability of buffaloe's and cow's milk varied at different months of lactation period but reach maximum stability in the mid-lactation. Cow's milk in Lower Egypt is characterized by distinctly poor heat stability at the beginning and the end of lactation if compared with buffaloe's milk. Statistically analysing the data of the two methods measuring heat stability of milk showed highly significant coefficient correlation. Recommendations for acceptance of raw milk, to ensure successful processing of sterile milk and milk powder were also given.

INTRODUCTION

The stability of milk proteins is a matter of great importance in many phases of dairy industry. Frequently an excessive losses of protein stability is the chief factor limiting the extent of processing many dairy proucts. During the last years, numerous attempts had been made to make sterile milk with long storage life from milk of our native breeds, but attempts did not continue, that may be, due to the instability of casein calcium phosphate complex during processing and storage (FARAGE, 1BD-ELAHH. 1966). The powdered milk industry is also facing some problems involving the stability of colloidal phase of milk. The rapidity of deterioration of dried milk powder markedly affects the acceptance of the products by the consumers. The available literature gives few informations about the variation in the heat stability of milk proteins during the various months of the lactation period.

The problem of protein stability of milk has been a subject of many investigations for a long time. SOMMER and BINNEY (1923)reported that there is no relation between the titratable acidity of fresh milk and its stability to ethanol. They observed also that when cow's were fed on a ration containing calcium carbonate their milk became unstable to ethanol, even though the total calcium content of milk was unaltered.

DAVIES (1939) mentioned that high albumin and globulin content undoubtly contributes to the instability of colostrum to heat,while PYNE (1958) mentioned that albumin and globulin does not affect the heat stability of milk unless their total concentsation exceeds 0.9%. HUGES and ELLISON (1949) quoted a report that cows grazing on lands with high calcium content usually secrete milk unstable to othanol. ROWLANDS (1950) stated that only one of 618 fresh bulk milk coagulates with 68% othanol,but with strong solution of ethanol, the incidence of unstable samples raised sharply espicially in districts proved to be rich in lime salt.

ROSE (1961) mentioned that the heat stability of milk varies markedly within a pH value ranging from 6.5 to 6.8, and often considerably increased by careful adjustment of the pH value, no significant relationship between Ca ion content and maximum heat stability was observed. ROSE (1962, 1963) mentioned that the main factors influencing heat stability of milk may be due to the presence of organisms secreting rennet like enzyme, concentration of the total solids, hemogenization, acidity, forewarming, albumin and globulin content, and possible differenes in casein content.

ZITTLE et al. (1962) stated that there is a relationship between B-lactoglobulin, K-casein of milk and its stability to heat. Milk that contains abnormal amount of albumin as milk in the first period of lactation, mastitic

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milk always coagulate with ethanol, also when exposed to the temperature of sterilization process (WEBB & JOHNSON 1965).

DAVILS and WHITE (1966) found that the coagulation time of individual Ayrshire cow skim milk at 135°C renged from 2.66 to 48.55 min. (Mean value 19.67 min. the SE of a single determination was to be ± 0.26 min). They advised to determine the heat coagulation time at a temperature in the range between 120-140°C, apparently so as to obtain coagulation time that are neither too long nor too short. Fresh cow milk that coagulate with 75% ethanol resist coagulation by heat at 130°C up to 5 hours, at 80% concentration milk remain about 10 hours (GDANOF and ALEKCEEF 1969)?

MAHMOUD et al. (1975) reported that, mixing of low heat stable cow and buffalo milk, clearly resulted in a significant increase in the heat stability of mixed milk particularly that containing increasing percentage of buffalo milk. The mixing of the two kinds of milk resulted in a gradula but slight decrease in the titratable acidity and increase of pH value. Heat stability of the mixture was markedly increased as the percentage of buffalo milk increased, yet did not exceed that of original buffaloe milk. The authors advised that, countries having cow and buffaloe milks such as Egypt and India can easily adopt such practice if needed than using stabilizer's for increasing heat stability of milk.

As buffaloe's milk constitutes the majority of milk produced in our country,the aim of this work was planned to evaluate heat stability of milk and milk obtained from imported breeds such as Friesian cow's, throughout the lactation period. The evaluation of such milk was done using two well known methods measuring the heat stability of milk. The reliability of which was also tested.

MATERIALS AND METHODS

Milk samples were obtained three times monthly from two selective groups of Egyptian buffaloe's and pure Friesian cows (three individuals for each group, all were delivered within one week) in two localities including Experimental Dairy Farm, Faculty of Agriculture, Assiut Univ. and Hawatka Dairy Farm, representing Upper Egypt and Sakha Mehalet Moussa dairy farms, Ministry of Agriculture Kafr El-Shiekh city, representing Lower Egypt.

A total of 96 bulk milk samples were examined throughout eight months lactation period excluding the first and late period of lactation. All the samples taken from complete morning milk, were conveyed immediately to the laboratory. The heat stability of milk was determined by measuring its heat coagulation time at 130°C according to BUROKOF (1973) using 2 ml. skim milk sample in sealed pyrex tubes (the fat was separated by centrifuging the whole fresh milk for 30 min. A hole was made in the layer of fat, a glass tube passed through and the separated milk removed by suction). Up to 6 tubes at a time were racked in a 130°C thermostatically controlled oil-bath. The time elapsed from the immersion of the tubes in the oil-bath till the appearance of visible coagulated particles in each milk sample was taken as a criterion for measuring the heat stability. In all cases duplicate tests were done and the results are recorded.

The stability of milk proteins to ethanol was determined according to WHITE and DAVIS (1958) by finding the strength of ethanol which cause clotting of an equal volume of milk. Thirteen aqueous solutions of ethanol were used covering the range from 66 to 90% with an interval of 2%. The test was performed starting with the highest concentration of ethanol (90% as control) then repeated with the other ethanol dilutions in order to decrease the strength until coagulation ceases. The strength of the weakest ethanol solution that caused coagulation was recorded.

Separated milk was used in all stability tests as removal of fat made it slightly easier to detect the onset of coagulation. Statistical analysis was carried out according to SNEDECOR (1955).

RESULTS AND DISCUSSION

The results of heat stability of milk from Egyptian bufaloe's and Freisian cows evaluated by oil-bath method in Upper and Lower Egypt were recorded in (Table 1 & Fig. 1&2). The results revealed that the coagulation time at 130°C is necessary to cause coagulation which varied with different milks at different months of lactations. Concerning the changes during the course of lactation, both buffaloe's and cow's milk showed low heat stability in early lactation especially in the first and second months, then gradually increased towards the mid lactation period. At the end of the lactation period heat stability of both kinds of milks decreased but was not significantly differed from that of the beginning of lactation. Buffaloe's milk reach maximum heat stability in the fourth and fifth months of lactation, while cow's milk was characterized by distinctly poor stability at the beginning of lactation and high stability in the fourth, fifth and sixth months of lactation, then sharply decreased towards the end. These results agree with that reported by DAVIES and WHITE (1958).

The average coagulation time of the whole lactation periods in Upper and Lower Egypt was 17.95, 19.02 min. for buffaloe's milk, while cow's milk required 15.58, 18,91 min., respectively. DAVIES and WHITE (1958) reported that coagulation time of herd bulk milk ranged from 17.2 to 59.0 min., while the range of individual samples of cow's milk was between 0.6 and 82.2 min. They also mentioned that there was a relation between heat stability of milk and stages of lactation.

Cow's milk proved to be characterized by higher heat stability in Lower Egypt than in Upper Egypt (+ 3.33 min.). It appears that this may be attributed to inviromental conditions, feeding systems and better accomodations of such breeds. It is also evident from the results obtained that buffaloe's milk has the same heat stability in both localities and seems not to be affected by climate, however, it slightly exceeds that of imported brees in Lower Egypt.

The stability of milk to ethanol in both localities is shown in (Table 2 and Figs. 3&4). The results revelaed that the strength of ethanol solutions necessary to cause coagulation also varied with different milk in different stages of lactation. At the first and late periods of lactation, it was noticed that milk usually require low concentration of ethanol. The higher concentration required to cause coagulation was noticed in the mid lactation period.

The average concentration of ethanol solution required to coagulate the caseinate complex of buffaloe's and cow's milk in Upper and Lower Egypt at the whole lactation period was 77.29, 74.54, 77.79 & 78.12%, respectively. The average stability of buffaoe's milk being the same in both localities and showed excess values in cow's milk only in Upper Egypt by 2.75% ethanol. In Lower Egypt, the stability of both cow's and buffaloe's milk practically were similar.

Ethanol test similarly evaluates heat stability of both kinds of milk to that of oil-bath method during lactation period. Buffaloe's milk that coagulate by 77.50% ethanol required 18.5 min. to coagulate by heat,while cow's milk that coagulae by 76.3% ethanol required 17.5 min. by the oil-bath method.

Statistical analysis of the data of both methods measuring the heat stability of milk from buffaloe's and cow's in Upper and Lower Egypt showed highly significant coefficient correlation as r equal + 0.971, + 0.924 + 0.951 and + 0.954, respectively ($P \angle$ 0.001). The higher concentration of ethanol, the longer the period of coagulation by heat. Obtained results run parallel to those obtained by DAVIES and WHITE (1958, 1966), GDANOF and ALEKCEEF (1969). The variations in heat stability during the lactation period could be attributed to the difference in their composition and physico-chemical quality of milk.

It is evident from the practice that, the higher heat stability of milk during processing, the longer the period of conservation. At present raw milk designed for ultra high temperature treatment must be of suitable quality both bacteriological and physically, hence the need for a test such as performed with 72% ethanol to ensure that the physical equilibrium of milk will remain after two to four month's conservation (KON, 1972).

In Italy, USSR, France and Austria, raw milk is not accepted for processing of ultra high temperature products unless pass 70, 75, 74, 80 - 85% ethanol, respectively (GDANOF and ALEKCEEF, 1969). The concentration of ethanol solution required for acceptance of milk from our native breeds ranged from 74 to 82%. Such milk remain approximately 18.5 min. if exposed to heat at 130°C. So it appears that our buffaloe's milk if produced under strict hygienic measures have nearly the same characteristics as regard to heat stability of milk from imported breeds (Friesian cows). To ensure successful processing of sterile milk from buffaloes it is recommended to test raw milk using oil-bath method at 130°C. This method is more easier and measures the heat stability of milk without adding any denaturating substances.

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TABLE (1)

Coagulation time at 130°C (min) of cow's and buffaloe's milk.

Months of lactation	Upper Egypt		Lower Egypt	
	Buffaloe's milk (average)	Cow's milk (average)	Buffaloe's milk (average)	Cow's milk (average)
I	15.33	13.17	16.83	15.16
II	17.00	13.17	17.17	17.08
III	19.67	14.75	20.50	19.33
IV	23.83	16.83	24.88	23.67
V	23.16	19.50	24.67	22.92
VI	17.33	19.67	19.16	22.58
VII	14.00	13.83	14.83	15.75
VIII	13.33	13.75	14.16	14.80
Average in lactation period	17.95	15.58	19.02	18.91
S E	1.40	0.97	1.14	1.32

TABLE (2)

Concentration of ethanol (%) require to coagulate cow's and buffaloe's milk.

Months of lactation	Upper Egypt		Lower Egypt	
	Buffaloe's milk (average)	Cow's milk (average)	Buffaloe's milk (average)	Cow's milk (average)
I	75.33	72.33	76.33	74.67
II	77.00	73.00	77.33	75.33
III	77.67	75.33	78.00	76.66
IV	81.00	75.66	82.33	82.00
V	80.33	76.33	80.66	82.66
VI	77.00	76.66	76.66	82.33
VII	76.00	73.33	76.00	76.33
VIII	74.00	73.66	75.00	75.00
Average in lactation period	77.29	74.54	77.79	78.12
S E	0.80	0.58	0.88	1.25

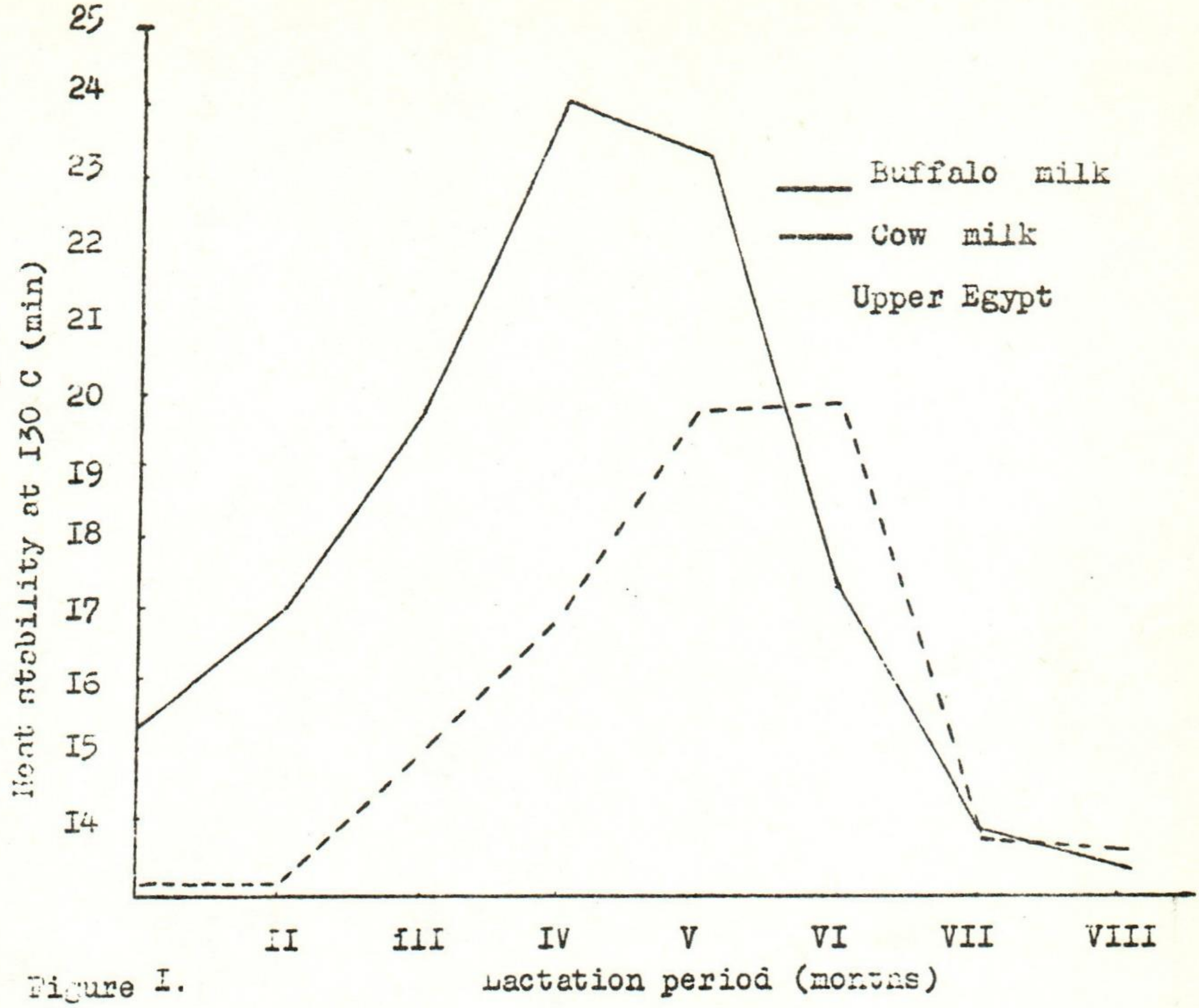

Figure I.

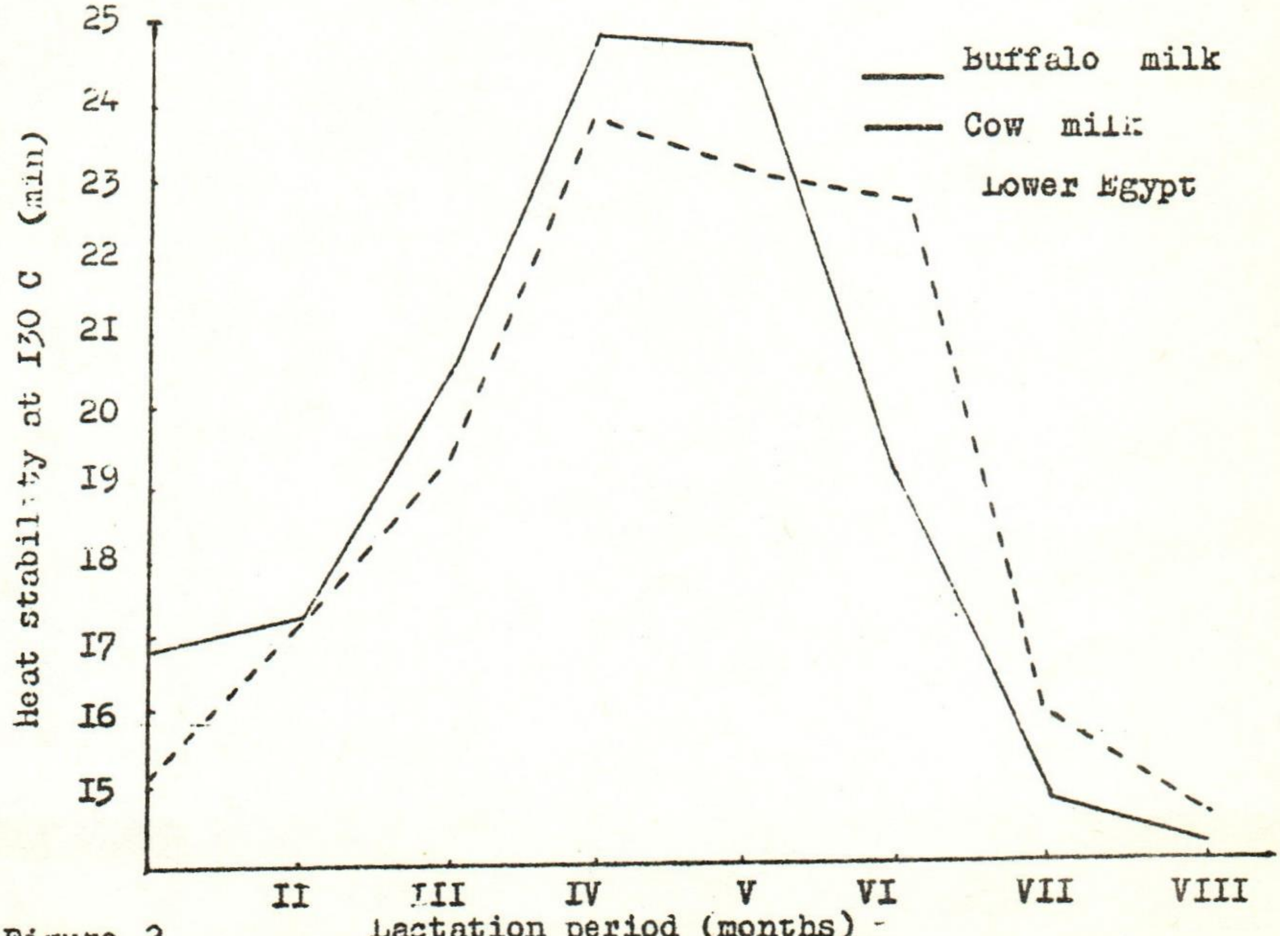

Figure 2

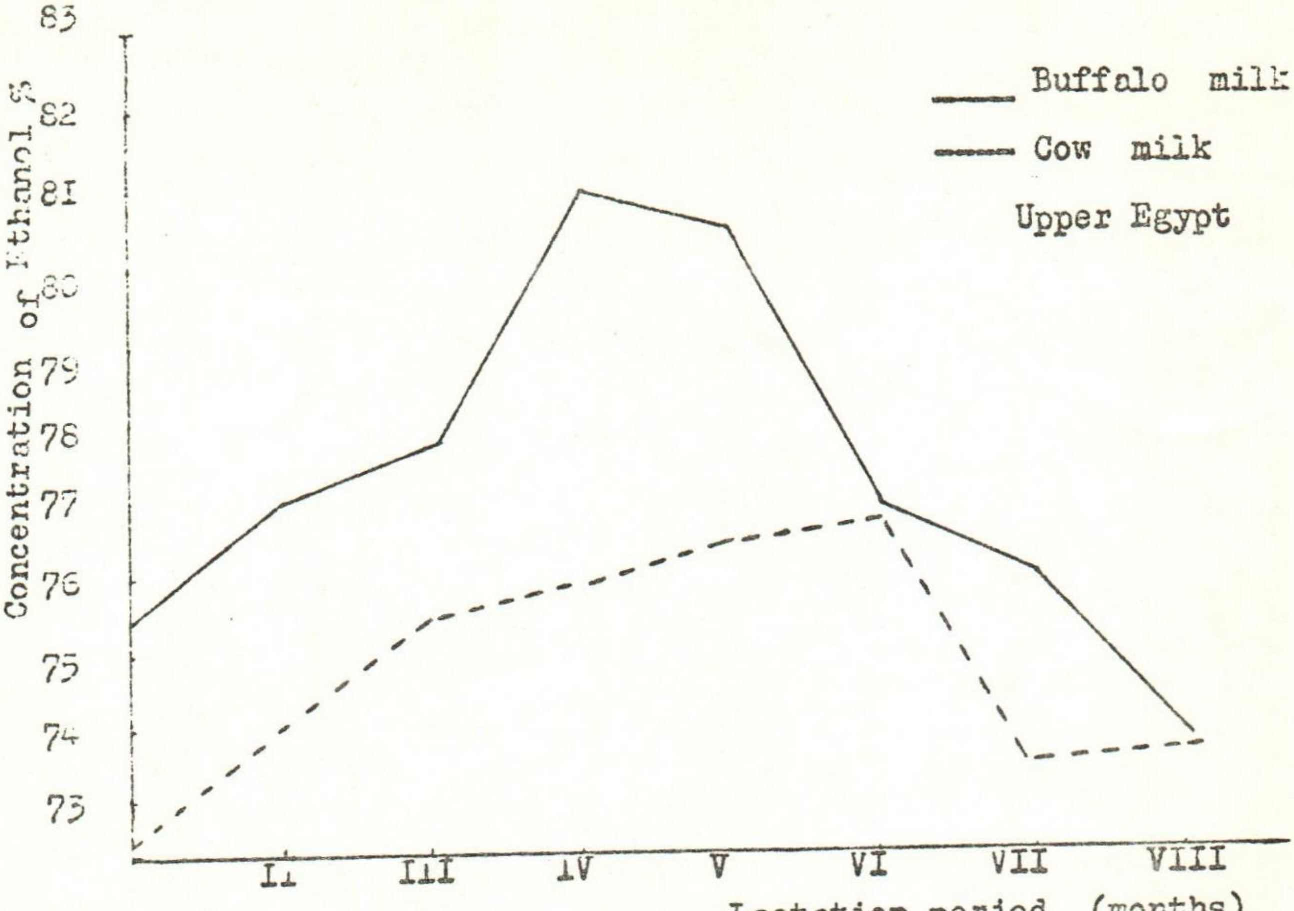

Figure 3.

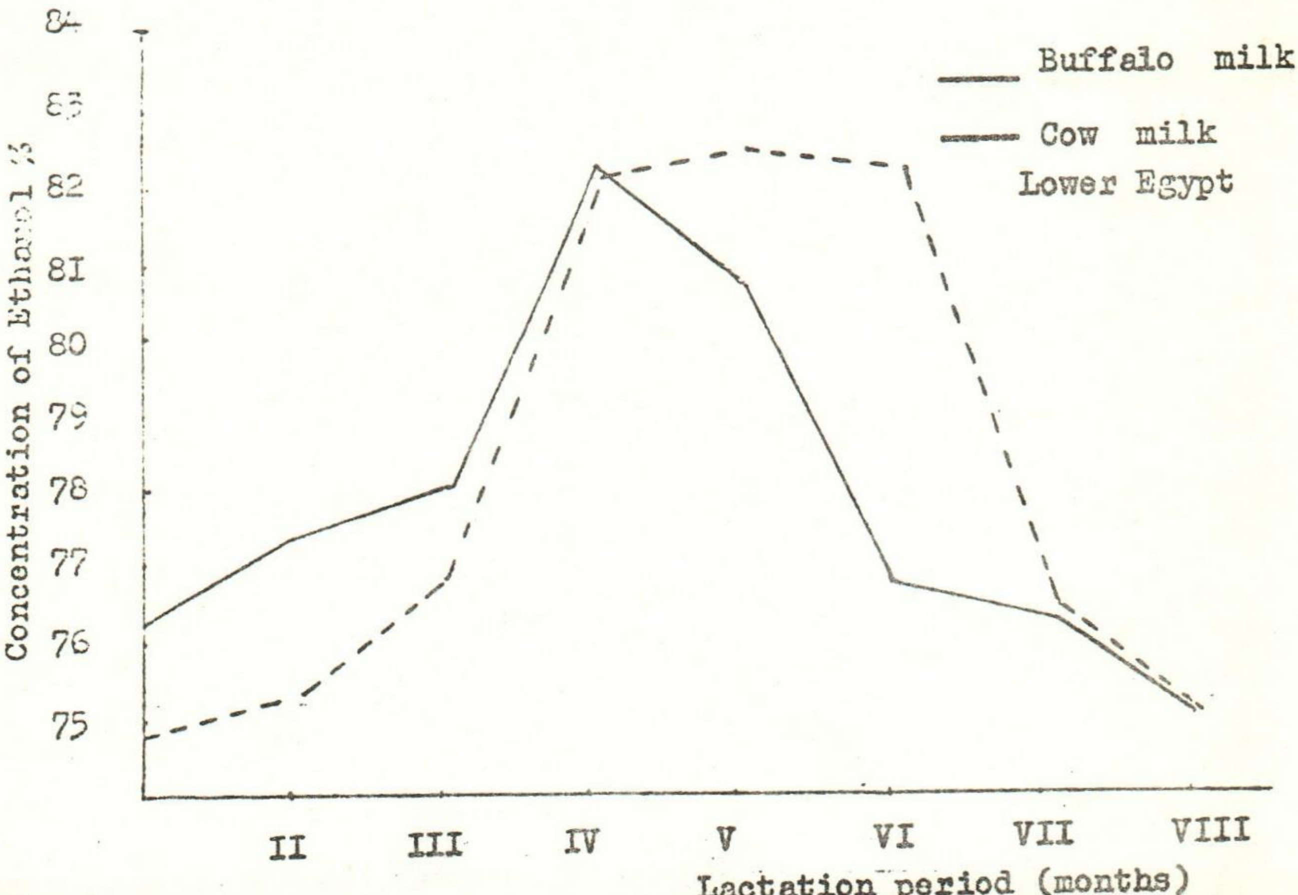

Figure 4.