قسم : الانتاج الحيواني .
كلية : الزراعة - جامعة أسيوط .
رئيس القسم : أ.د / حاتم الحمادى

تأثير موسم الولادة بالفريزيان والجاموس المصرى على أنماط بروتين اللبن الناتجه بالفصل الكهربائي

ابراهيم سالم ، فاروق عـلام ، حسن دغش

أجريت هذه الدراسة على ١٢ بقره فريزيان حلابه ، ٢٥ جاموسه مصرية بمزرعة الانتاج الحيواني بكلية الزراعة - جامعة أسيوط.

وقد أخذت العينات الشهرية من ٤ حلبات متتاليه من كل حيوان طوال فترة البحث وتم تحليلها بالنسبة للبروتين وكذلك قدرت عناصر بروتين اللبن عن طريق الفصل الكهربائي .

ويمكن تلخيص النتائج التي تم الحصول عليها فيما يلي :

- وجد ارتفاع معنوى في كمية اللبن المنتجه من حيوانات كلا النوعين والتي ولدت في الشتاء بالمقارنه بانتاجية تلك الحيوانات التي ولدت في الصيف كذلك تميز لبن كلا النوعين من الحيوانات والتي ولدت في الشتاء بارتفاع معنوى في كلا نسبة البروتين وكذلك نسبة الا مينوجلميولين بالمقارنة بلبن الحيوانات التي ولدت في الصيف .
- مكونات اللبن الأخرى التى درست لم تتأثر بموسم الولادة .
- لم يحدث أى تأثير تفاعلي معنوى بين نوع الحيوان وموسم الولاده أو بين موسم الولاده وفترات الحليب المختلفه على انتاج اللبن وتركيبه الكيماوى .

Dept. of Animal Production,
Faculty of Agric., Assiut University,
Head of Dept. Prof. Dr. H.Y. El-Hammady.

ELECTROPHORETIC PATTERNS OF MILK PROTEIN AS AFFECTED BY CALVING SEASON OF BUFFALOES AND FRIESIAN COWS

(With 11 Tables)

BY
I.A. SALEM; F.M. ALLAM and H. DAGHACH

(Received at 25/8/1983)

SUMMARY

Twelve lactating Holstein-Friesian and twenty five lactating Egyptian buffaloes belonged to the experimental Station of Assiut University, were used throughout this study. Representative monthly samples from four successive milkings were collected from each animal. Sampleswere immediately used for the determination of total milk proteins and its electrophoretic fractions.

Resuls obtained can be summarized as follows: Calving season had a significant (P/ 0.05) effect only on total milk yield, total milk protein % and immuno-globulin fraction of milk whey protein. Thus, winter calvers of both genus yield more milk and protein and immunoglobulin than summer calvers.

Other milk chemical compounds were not significantly affected by animal's calving season. Also, milk yield and composition were unaffected by genus x calving season interaction or calving season x lactation period interaction.

INTRODUCTION

The composition of milk is influenced by several factors. Among these factors are the breed, lactation period, calving season, time and numbers of milkings ... etc. Intensive studies were done about the effect of calving season on some milk composition i.e. milk fat, SNF, total milk proteins etc. (CASTILLO et al. 1963; DAVIDOV, 1963; HEROLD, 1965; EL-HOMMOSI, 1968).

However, about the electrophoretic patterns of milk protein, the information is lacking. Much of the informations provide only the average composition of bulk milk of each bread. In addition, adequate data on the distribution of the milk proteins between the whey and casein fractions are not available. Since the purpose of this work gave an approach about the influence of calving season on lactation period and milk protein percentage, yield and its electrophoretic pattern.

MATERIAL and METHODS

The present work was done on twelve lactating Holstein-Friesian (4-6 years old) and twenty five lactating Egyptian buffaloes (3-4 years old). The animals belonged to the experimental Station of Assiut University. The cows were in their first to third lactation while buffaloes were all

in their first lactation. Animals were kept in open yards with provisions for shade and feeding. They were hand milked twice a day at 6 a.m. and 5 p.m.

A representative monthly composite samples from four successive milkings were collected from each animal throughout the experimental period. Samples were immediately used for the determination of total milk proteins and its electrophoretic fractions. The total nitrogen was determined by micro-Kjeldahl-method (OGG et al. 1948). Total nitrogen was then multiplied by the factor 6.38 to obtain the percentage of total milk proteins.

Milk serum protein fractions were determined by the paper electrophoresis method (BLACK et al. 1958) using veronal buffer solution at pH 8.6. The casein fractions were determined using the paper electrophoresis, described by VLODAVETS (1967) as modified by the Labratory of Academy of TEMREIAZEF USSR (1973).

Data were analysed according to SNEDECOR and COCHRAN (1969).

RESULTS

Results are shown in Tables 1 - 11.

DISCUSSION

The adjusted milk yield - 305 days lactation of Friesian and buffaloe cows calved at winter or summer are shown in Table (1). Analysis of variance (Table 2) indicated that both Friesian and buffaloe cows calved during winter produced significantly more on 305 days lactation as compared to those calved during summer months. Analysis of variance also showed that there were no significant interaction effects between season of calving and any of the genus or stage of lactation on 305 days milk production.

Table 1 shows that milk total protein percentage significantly ($P/\_ 0.05$) affected by calving season while milk protein yields was not affected. Milk protein percentage for Friesian and buffalo cows calved during summer was higher than those of winter calvers. However, the significantly affected by calving season only on total protein percentage was shown only with Friesian but not with buffaloes. On the other hand, for protein yield, the winter calvers whether Friesian or buffaloes had the higher ($P/\_ 0.01$) protein yield in their milk compared with those in summer calvers. The interactions between season of calving and genus or stage of lactation were of insignificant effect on either total milk protein percentage or yield.

Table 3 indicated that protein percentage started at a low level in both Friesian and buffaloes calved in winter and summer decreased to a low level during second month of lactation, then increased in unidentified pattern toward the end of lactation to reach a highest value during the tenth month of lactation.

It was also found that, the protein percentage of milk of the summer calvers started at a relatively high level for Friesian and buffaloes than that of the winter calvers. These results were in agreement with that of KAMAL (1965) and NAZARKIN (1966).

Table 4 shows that, the milk protein yield started at low level in both Friesian and buffaloes that calved in winter and summer and then increased to reach the high level during the second and third month in winter and summer calvers, respectively. Milk protein yield of both genus was then decreased toward the end of lactation in a fluctuated pattern with a slight increase

at the end of lactation. These results were in agreement with those found by KAMAL (1956), EL-HOMMOSI (1968) and JANICKI (1974). EL-HOMMOSI (1968) showed that, the relative rise in milk yield during the end of the lactation period in summer calvers was the reason for the observed increase in the yeild of milk protein.

Milk serum protein and casein fractions:

The average of milk albumin % for Friesian and buffalo cows that calved during summer was higher than that of animals calved during winter (Table 5).

As shown in Table 5, milk albumin percentage for Friesian and buffaloes that calved during winter started at a relatively low level compared with those calved in summer. Values were increased from the fifth month of lactation till the end of lactation. While for summer calvers, milk albumin for Friesian and buffaloes began at a relatively high level than those of winter calvers. Afterwards, it declined during mid-lactation and then increased again towards the end of lactation.

For Friesian cows that calved in winter (Table 6) the beta-lactoglobulin percentage was low at the first month of lactation (40.53%), increased to reach a maximum level at the fourth month (50.01%) and then decreased till the end of lactation. On the other hand, for summer calvers, the beta-lactoglobulin started at a maximum level (51.39%), decreased gradually to reach a minimum level at the sixth month of lactation (39.68%) and then increased again towards the end of lactation period to a level not comparable with that of the first and second month of lactation period. On the other hand, buffaloes that calved during winter, the beta-lactoglobulin was maintained nearly at the same level throughout the lactation period except at the fourth month when it reached a maximum level of 45.93%. While in summer calvers, it began at low level (39.55%), increased to reach its maximum at the 3rd month (45.07%) and then decresed till the end of lactation period. These results support the findings of ASLANYAN (1965).

Milk alpha-lactalbumin % for Friesian and buffaloe cows that calved during summer exceeded ($P/ 0.05$) that of the winter calvers. Data in Table 7, revealed that for winter calvers of both Friesian and buffalo cows, the alpha-lactalbumin percentage was more or less maintained at the same level throughout the lactation period. On the other hand, alpha-lactalbumin in the milk of the summer calvers started at a low level, gradually increased to reach the maximum level during the fifth month, and then decreased till the end of lactation period. These results were similar to those of BOUCHARD and BRISSON (1969).

Results in Table 1, indicate that, the milk serum of winter calvers of both Friesian and buffalo cows had a higher level of immunoglobulin compared with that of summer calvers, the differences being significant ($P/ 0.01$). In winter calvers Table (8) the milk serum started with a high level of immunoglobulin in both Friesian and buffaloes milk, gradually decreased to reach a minimum level during the fifth month and then slightly increased toward the end of lactation period. In summer calvers the immunoglobulin % in milk of Friesian and buffaloes started at low levels, gradually increased to reach its maximum level during the sixth month and then decreased slightly till the end of lactation period.

Table 9, revealed that, milk alpha-casein % for Friesian and buffaloes that were calved during winter or summer were more or less the same, with insignificant differences within species. Values were 43.87 and 43.04% for Friesian and 41.36 and 41.33% for buffaloes calved at winter and summer, respectively. On the other hand, milk from both species calved at summer were found to contain more ($P/ 0.01$) beta-casein but less ($P/ 0.01$) gamma casein than milk of those calved at winter months (Tables 10 and 11).

The percentage of alpha-casein in milk started at a high level and increased to reach a maximum level at the second month for winter calvers in Friesian and the third month in buffaloes. The percentage of alpha-casein in the milk of winter buffalo calvers began at a low level than those of summer calvers. Values were then began to increase till the third month for winter calvers and the fifth month for summer calvers, afterwhich they decreased again in unidentified pattern to reach a maximum level at the tenth month.

The percentage of beta-casein started at low level comparable to that of summer calvers high level, by Friesian. Values were then decreased to reach a maximum level at the second month, after which they increased again to a maximum level at the seventh month for the winter calvers and the sixth month for the summer calvers. Values were then decreased again gradually toward the end of lactation period. For buffaloes calving during winter, the percentage of beta-casein in milk serum started at a high level compared with that of the summer calvers and decrease gradually toward the end of lactation. While in summer calved Friesian, beta-casein % began at a low level, increased to a maximum level during the third month of lactation and then decreased again to a minimum level during the tenth month of lactation.

Table 11, revealed that gamma-casein % in both Friesian and buffaloes calved during winter started at a relatively low level than those of summer calvers. The gamma-casein of the winter calvers of both genus began to increase gradually to reach a maximum level at the sixth month of lactation, and then declined again to reach a minimum level at the tenth month of lactation. On the other hand, in summer calvers, gamma-casein % started at a high level in the milk of Friesian and buffalo cows, decreased gradually to a minimum level at the fifth month of lactation, and then increased again to reach a minimum level at the tenth month of lactation comparable to the values at the beginning of lactation.

REFERENCES

Aslanyan, E.S. (1965): Changes in casein fractions and serum proteins of buffaloe's milk during lactation. Mater. Dokl. Konf. Molodijknauch. Rabotn., Eevansk. Zoovet. Inst. 73-77.

Block, R.J., Durrum, E.L. and Zweig, G. (1958): A mannual of Paper Chromatography and Paper Electrophoresis. New York (1958).

Bouchard, R. and Brisson, G.J. (1969): Changes in protein fractions of ewe's milk throughout lactation. Can. J. Animal Sci. 49, 143.

Castillo, L.S.; Trimberger, G.W.; Handerson, G.R.; Herrington, E.L. and Turk, K.L. (1963): Variation in Protein S.N.F. and fat of milk. Phillip. Agr. 46: 618.

Davidov, R.B. (1963): Factors affecting the protein content of milk. Vesten. Sol. Hoz. Nauk. 8(1): 78.

El-Hommosi, F.F. (1968): Effect of some environmental factors on milk production in Jerseys and its Grades. M.Sc. Thesis-Assiut Univ.

Herold, I. (1965): The effect of season on the production of milk, milk protein and butterfat of Hungarian Spotted cow. Kiserl. Koze Allaten. No. (64) 3.

Janicki (1974): Effect of month of calving on milk yield and composition in first lactation of Polish Black and White Lowland cows in breeding herds in Poznon-province. Roczniki Akad. Rolnicz. Pozananiu 74 (51-61).

Kamal, T.H. (1956): The effect of stage of lactation, season of calving and age of the buffaloes on th yield and composition of milk. M.Sc. Thesis, cairo Univ.

Nazarkin, E.Y.A. (1966): Serum protein and its fractions during lactation period of Jersey and its crosses. Ph.D. Thesis, Vet. Acad. Moscow. USSR.

Ogg, G.L.; Brand, R.W. and Whillits, C.O. (1948): Micro and semimicro determination of N: in heterocyclin N. ring compounds by a Kjeldahl method. J. Assoc. Off. Agr. Chem. 31, 663.

Snedecor, C. and Cochran, W. (1969): Statistical Analysis. Iowa State University Press. Iowa, USA.

Temreiazef, E. (1973): Book Of Methods Of Analysis For Milk And Milk Products. Moscow, USSR.

Vlodavets, E.N. (1967): Some problems about the chemistry of milk. Scientific Congress of Technology, Physiochemical and Industry of Food. Moscow, USSR 1967.

ACKNOLEDGEMENT

The suthors wish to express appreciation and thanks to Dr. Esmat Ibrahim, Lecture of Milk Technology, Faculty of Agriculture, Assiut University for her help during the course of Experimentation.

Table (1): The mean and standard error of protein (g%) and its yield, fraction of whey and casein in Friesian and buffaloe's milk during winter (W) and summer calving (S)

Milk constituents	Holstein Friesian		Egyptian buffaloes	
	W $\bar{X}$ (SE)	S $\bar{X}$ (SE)	W $\bar{X}$ (SE)	S $\bar{X}$ (SE)
Milk yield Kg/305 d.	3230 ± 106	2776 ± 88	1377 ± 82	1170 ± 72
Protein, g%	3.22 ± 0.07	3.57 ± 0.04	4.25 ± 0.05	4.36 ± 0.11
Protein yield Kg/mon.	11.70 ± 0.58	9.70 ± 0.19	6.80 ± 0.14	6.00 ± 0.19
Casein, g%	2.48 ± 0.07	2.70 ± 0.05	3.51 ± 0.08	3.48 ± 0.13
Albumin, %	6.7 ± 0.21	7.30 ± 0.26	7.10 ± 0.16	7.7 ± 0.20
Beta-lactoglobulin, %	44.0 ± 0.65	43.9 ± 0.83	41.5 ± 0.36	41.3 ± 0.44
Alpha-lactalbumin, %	20.9 ± 2.29	21.7 ± 0.22	22.9 ± 0.16	23.6 ± 0.27
Immunoglobulin, %	28.5 ± 0.41	27.1 ± 0.49	28.5 ± 0.25	27.5 ± 0.30
Alpha-casein, %	43.9 ± 0.57	43.0 ± 0.74	41.4 ± 0.34	41.3 ± 0.48
Beta-casein, %	41.3 ± 0.31	43.3 ± 0.07	42.1 ± 0.26	44.1 ± 0.46
Gamma-casein, %	14.8 ± 0.20	13.70 ± 0.32	16.5 ± 0.16	14.6 ± 0.20

Table (2): Mean squares of milk yield and its constituents during lactation period for Friesian and buffalo cows

Source of variation	Milk yield	Protein %	Protein yield	Milk serum protein fracts 1	2	3	4	Casein fracts		
Genus (G)	264290.9**	55.04**	133.2**	0.06	5.46	4.35	6.35	173.1**	62.8**	27.3**
Season (S)	4235.4*	11.64*	1.55	0.01	6.68	0.15	10.7*	0.005	0.050	0.106
Lactation(P)	4289.8*	3.47	3.69	1.54	6.30	0.95	2.67	11.62**	4.69	2.00
G X S	809	3.60	0.137	0.12	0.08	0.04	0.06	4.42	0.84	1.40
S X P	1081.8	4.87	2.56	1.14	9.56	0.84	6.44	4.30	3.40	1.44

* Significant at 5% level ** Significant at 1% level
(1, Albumin 2, Beta-lactoglobulin 3, Alpha-lactalbumin 4, Immunoglobulin).

Table (3): Average of protein percentage of Friesian and buffaloes during winter (W) and summer calvings (S)

Species	Calv. Season	MONTHS OF LACTATION I	II	III	IV	V	VI	VII	VIII	IX	X
Friesian	W	3.41± 0.14	3.16± 0.21	3.27± 0.55	3.44± 0.24	3.08± 0.18	3.03± 0.19	3.26± 0.14	3.45± 0.34	3.22± 0.13	3.6± 0.2
	S	3.57± 0.06	3.22± 0.05	3.77± 0.61	3.24± 0.31	3.74± 0.32	3.73± 0.28	3.54± 0.32	3.47± 0.23	3.44± 0.33	3.6± 0.1
Buffaloes	W	4.20± 0.48	3.65± 0.14	4.37± 0.36	4.48± 0.27	4.52± 0.28	4.76± 0.32	4.59± 0.30	4.53± 0.54	4.33± 0.26	4.9± 0.3
	S	5.05± 0.74	4.75± 0.34	3.55± 0.07	3.76± 0.40	4.19± 0.43	4.45± 0.62	4.54± 0.41	4.33± 0.39	3.84± 0.82	4.7± 0.2

Table (4): Average of protein yield of Friesian and buffaloes during winter (W) and summer calvings (S)

Species	Calv. Season	MONTHS OF LACTATION I	II	III	IV	V	VI	VII	VIII	IX	X
Friesian	W	10.33± 0.81	12.97± 1.77	14.14± 2.41	12.78± 1.53	10.61± 1.71	9.06± 0.68	8.14± 0.73	7.07± 0.30	7.18± 1.05	9.48± 1.26
	S	11.04± 0.25	10.7± 0.10	10.05± 1.17	8.54± 0.59	10.05± 1.14	8.82± 0.76	8.84± 0.90	9.50± 1.05	8.94± 0.91	9.59± 1.05
Buffaloes	W	5.00± 1.18	6.76± 0.69	7.13± 0.68	6.97± 0.41	7.32± 0.61	6.81± 0.58	6.54± 0.66	5.83± 0.52	5.15± 0.63	6.28± 0.88
	S	8.03± 0.98	8.10± 1.43	4.93± 0.38	5.61± 0.56	5.51± 0.97	5.79± 1.11	6.26± 0.82	5.56± 0.57	4.75± 1.37	6.26± 0.21

Table (5): Average of albumin percentages of Friesian and buffaloes during winter (W) and summer calvings (S)

Species	Calv. Season	MONTHS OF LACTATION I	II	III	IV	V	VI	VII	VIII	IX	X
Friesian	W	5.85± 0.42	6.67± 0.55	6.57± 0.51	6.39± 0.65	7.66± 1.07	7.61± 0.90	8.59± 1.26	7.43± 0.85	8.92± 1.21	9.55± 1.60
	S	6.87± 1.61	6.80± 1.91	9.32± 1.20	8.21± 3.42	6.58± 0.95	7.40± 1.68	7.44± 1.13	8.29± 1.08	9.28± 1.79	7.33± 1.24
Buffaloes	W	7.15± 1.22	7.08± 1.26	6.25± 0.74	7.66± 1.20	8.54± 1.21	7.25± 0.70	7.85± 1.03	9.57± 1.85	8.26± 1.30	6.28± 1.20
	S	7.96± 1.76	7.02± 1.82	8.63± 1.30	5.98± 1.35	9.55± 1.46	5.51± 0.82	8.46± 1.01	8.47± 1.97	7.34± 1.80	7.62± 1.01

Table (6): Average of beta-lactoglobulin % of Friesian and buffaloes during winter (W) and summer calvings (S)

Species	Calv. Season	MONTHS OF LACTATION I	II	III	IV	V	VI	VII	VIII	IX	X
Friesian	W	40.53± 2.10	44.94± 2.17	44.29± 1.20	50.01± 2.93	41.03± 1.60	42.33± 1.72	41.15± 2.92	42.21± 2.71	42.73± 2.53	38.52± 1.54
	S	81.39± 0.24	47.03± 1.21	43.06± 2.10	40.26± 2.62	40.07± 2.51	39.68± 2.46	42.47± 2.08	42.33± 2.01	41.71± 1.33	41.42± 2.10
Buffaloes	W	41.85± 1.69	39.78± 2.16	40.98± 1.38	45.93± 2.42	38.44± 2.70	40.44± 2.03	43.75± 2.24	41.79± 0.85	41.10± 1.66	41.02± 1.56
	S	39.55± 2.17	44.20± 1.58	45.07± 2.36	41.99± 2.41	36.89± 2.11	41.71± 1.33	43.53± 2.15	41.62± 1.68	41.88± 2.91	41.82± 1.93

Table (7): Average of alpha-lactalbumin% of Friesian and buffaloes during winter (W) and summer calvings (S)

Species	Calv. Season	MONTHS OF LACTATION I	II	III	IV	V	VI	VII	VIII	IX	X
Friesian	W	21.56± 0.87	20.73± 1.20	23.72± 1.01	20.47± 1.50	21.75± 1.59	22.19± 1.80	21.74± 2.21	20.69± 2.30	20.28± 2.27	20.08± 1.30
	S	21.67± 1.13	21.73± 0.67	21.45± 1.96	23.72± 2.18	24.47± 2.16	22.36± 1.50	22.82± 1.58	22.14± 1.54	21.36± 1.58	21.28± 2.26
Buffaloes	W	21.96± 0.81	23.61± 1.80	21.54± 1.01	23.52± 0.80	23.30± 1.20	23.55± 1.50	22.43± 1.09	22.87± 1.26	21.13± 0.96	21.24± 1.96
	S	22.99± 1.69	21.81± 1.39	23.52± 1.50	22.77± 1.09	25.64± 1.91	23.18± 1.35	22.18± 1.22	22.72± 1.73	22.23± 2.13	22.08± 1.47

Table (8): Average of immunoglobulin % of Friesian and buffaloes during winter (W) and summer calvings (S)

Species	Calv. Season	MONTHS OF LACTATION I	II	III	IV	V	VI	VII	VIII	IX	X
Friesian	W	29.17± 1.17	28.14± 1.44	27.60± 2.10	27.04± 2.30	24.35± 2.78	25.47± 1.92	26.32± 2.62	26.90± 2.06	27.47± 0.89	27.34± 1.29
	S	22.64± 0.60	22.76± 0.86	24.18± 0.82	24.68± 1.68	26.54± 2.75	30.38± 2.00	27.99± 2.31	27.73± 1.50	26.63± 1.73	26.78± 2.31
Buffaloes	W	30.14± 1.53	29.29± 1.54	29.76± 0.80	27.05± 0.80	25.95± 1.60	27.63± 1.58	27.61± 1.21	27.38± 1.52	28.05± 1.72	28.70± 1.88
	S	24.02± 1.50	26.13± 1.43	27.42± 1.53	28.27± 1.68	28.87± 1.01	29.51± 1.17	27.35± 1.21	27.27± 1.45	27.55± 1.20	25.05± 1.31

Table (9): Average of alpha-casein% of Friesian and buffaloes during winter (W) and summer calvings (S)

Species	Calv. Season	MONTHS OF LACTATION I	II	III	IV	V	VI	VII	VIII	IX	X
Friesian	W	46.78± 2.67	46.87± 1.54	45.14± 1.47	45.95± 2.53	45.71± 2.22	45.71± 2.00	43.61± 1.12	43.02± 1.23	43.34± 3.20	42.55± 2.61
	S	46.38± 2.12	46.71± 1.80	47.83± 1.20	46.03± 2.62	46.12± 1.56	45.87± 2.54	45.09± 2.24	44.92± 2.71	42.77± 2.37	38.62± 1.64
Buffaloes	W	39.84± 2.43	40.35± 2.89	42.92± 2.64	37.97± 1.07	40.77± 2.90	38.46± 1.76	37.55± 2.32	38.01± 2.01	40.75± 2.40	43.78± 2.91
	S	41.22± 3.58	41.12± 2.34	42.08± 1.76	43.38± 3.08	45.81± 3.02	43.32± 2.36	42.79± 2.75	91.44± 3.76	41.33± 2.80	40.89± 1.57

Table (10): Average of beta-casein% of Friesian and buffaloes during winter (W) and summer calvings (S)

Species	Calv. Season	MONTHS OF LACTATION I	II	III	IV	V	VI	VII	VIII	IX	X
Friesian	W	40.16± 3.29	38.91± 2.48	41.28± 2.10	40.46± 2.40	41.99± 2.10	42.64± 2.30	43.07± 2.50	42.97± 2.02	41.95± 2.47.	39.21± 1.74
	S	40.79± 3.57	41.11± 3.25	41.56± 2.85	42.29± 2.10	42.70± 3.20	44.85± 3.80	41.70± 1.53	40.72± 0.97	40.18± 2.06	38.65± 2.32
Buffaloes	W	46.95± 2.66	45.04± 2.44	45.69± 2.52	45.81± 1.69	44.69± 1.88	44.12± 0.96	43.95± 1.45	42.64± 1.78	42.10± 2.93	42.47± 0.82
	S	41.69± 2.11	41.84± 1.34	47.09± 2.10	45.19± 2.94	43.07± 2.85	44.82± 2.07	45.85± 2.38	44.49± 2.39	45.54± 3.21	41.20± 1.86

Table (11): Average of gamma-casein% of Friesian and buffaloes during winter (W) and summer calvings (S)

Species	Calv. Season	MONTHS OF LACTATION I	II	III	IV	V	VI	VII	VIII	IX	X
Friesian	W	13.47± 1.16	13.52± 1.33	13.60± 1.10	14.18± 1.41	14.24± 1.37	15.16± 1.80	13.60± 1.23	13.49± 1.53	13.27± 1.80	12.87± 1.70
	S	15.03± 0.80	14.00± 1.12	14.41± 1.12	14.69± 0.96	11.57± 0.89	12.62± 1.75	14.99± 0.75	14.69± 1.96	16.15± 2.82	16.96± 1.85
Buffaloes	W	15.54± 1.08	15.86± 1.32	16.18± 1.07	16.17± 0.93	16.79± 1.35	16.64± 1.19	16.48± 1.90	16.26± 1.65	15.75± 1.35	15.28± 1.75
	S	16.70± 0.73	16.32± 2.22	14.83± 1.81	14.11± 1.16	13.12± 0.93	15.69± 1.21	10.87± 1.62	16.68± 0.37	16.10± 0.65	16.96± 1.11