THE FEEDING VALUE OF MILK AND COLOSTRUM FED TO YOUNG BUFFALOE AND COW CALVES USING DIGESTIBILITY TECHNIQUE

II.—A Study on the Colostrum During the Postnatal Days

By

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SUMMARY

Digestibility trials with 7 Friesian and 6 buffalo male calves fed colostrum were undertaken to study its digestion and the feeding value during the first 8 days of life in three successive intervals of 48, 72 and 72 hours. Each calf was fed individually from nipple pail his mothers colostrum. Carmine indicator was used as a faecal marker. Results indicated that there was no difference between the two species in digestion coefficients of each specific nutrient at the same interval. There were also no differences in digestion coefficients of fat or carbohydrates during the three intervals in the two species. There were significant differences between the digestion coefficients of protein between *1st* and *2nd* interval or *1st* and *3rd* interval, the difference between the *2nd* and *3rd* interval was not significant. The average digestion coefficients for colostrum in both species could be taken as 96.6 for dry matter, 98.3 for fat and 98.3 for carbohydrates. For protein the average would be 96.4 for *1st* interval and 92.2 for both the *2nd* and *3rd* intervals. The figure for total digestible nutrients in the colostrum was practically equal to that of the starch value. The feeding value was distinctly high in the first period, then a little drop was between the *2nd* and *3rd* period when the feeding value was similar to whole milk. The average starch value for the successive period was 22.5 (19.2-24.9), 18.1 (15.9-20.7) and 17.6 (15.1-19.2) with cows being 29.2 (24.6-33.6), 25.3 (21.3-30.4) and 23.9 (22.0-26.5) with buffaloes. Buffaloes colostrum as fed contains respectively ca. 30, 39 and 35% more starch value than cow's. The dry colostrum contained 120.1, 127.1 and 134.0 starch value in the successive periods against 130.3, 141.0 and 139.8 in buffaloes, the feeding value increasing successively to approach that in whole milk. The feeding value with buffaloe's colostrum was 8.5, 10.6 and 3.9% more than with cows in the successive periods becoming practically of the same value at the last period. The colostrum for buffaloes as fed contains slightly higher digestible protein. On dry matter basis, cows colostrum contains higher digestible protein in the *1st* and *2nd* period but similar content at the *3rd* period as buffaloes.

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INTRODUCTION

In a previous paper[1] by the authors, a study of the feeding value of buffaloe's and cow's milk fed to calves during their early weeks after birth was undertaken. The variation in digestion coefficients among calves with milk nutrients was studied along with a comparison between buffaloe's and cow's milk. There was no difference between buffaloe's and cow's milk in average digestion coefficients for nutrients. The respective average digestion coefficients of 94.0 97.7 and 97.2% could be taken for protein, fat and carbohydrates for the whole milk both species, being slightly lower with protein. It was also found that 4 parts of cow's milk as fed equal 3 parts of buffaloe's milk in providing the same starch value; buffaloe's milk as fed contained 20% more digestible protein. Both milks when dry have practically the same starch value and digestible protein.

Nowadays several efforts are directed for saving the whole milk in calf feeding by early weaning (2,10) and using milk substitutes (7,8) Other workers investigated the possibility of replacing some of the whole milk itself with surplus colostrum which is available with big herds. (5,6) Little information is available about the feeding value of colostrum particularly throughout the first days after birth when considerable change occurs in its composition. Some work was published by Parrish *et al.* 1953 (9) to study the properties and digestiblity of colostrum of the dairy cow using calves during the early postnantal days of life. Their study was during the first 8 days divided into three successive periods. 1-2, 3-4 and 5-8 days. Carmine indicator was used to differentiate between different periods. They found that the digestion coefficients of nutrients ranged between 90 and 99% being less than 90% in protein during the *2nd* and *3rd* period.

Therefore, this work was undertaken with colostrum as continuation to the preevious investigations with whole milk to fill a gap in our knowledge under our conditions particularly with buffaloes. Some data were published about the change in composition of colostrum during the *lst* days of lactation with local cows and buffaloes (4). It was found in both species that the colostrum contains higher percentage of dry matter, protein and ash and lower percentage of sugars than normal milk. But buffaloes colostrum contains less fat than normal buffaloe's milk whereas cows colostrum was richer in fat than normal cow's milk.

The present study was considered necessary to find out the variations in digestion coefficients and feeding value during the first 8 days after parturition along with the respective changes in the contents of the major nutrients in colostum.

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(1) Submitted for publication 1963.

EXPERIMENTAL AND METHODS

Animals experimented on were 7 Freisian male calves from the Ministry of Agriculture Experiment Station at Sakha and 6 buffalo calves from that at Mehallet Moussa nearby. They were kept in metabolism boxes directly after birth, then artificially fed thier mother's colostrum by nipple pail. The postnatal period of 8 days was subdivided into 3 successive periods of 48, 72 and 72 hours, respectively. Carmine was used as a faecal marker to differentiate between periods. The food was offered twice daily at 8.30 a.m. and 5.0 p.m. (at two milkings). The rest of the procedure for faecal collection,storing and sampling was similar to that in the previous paper and to that of Parrish *et al* (9). Separate individual food samples were prepared for each calf during each period.

Analytical methods for the summative analysis followed those in the previous paper. Determing the fat was directly in the food and faecal sample without drying by dehydrating with anhydrous-sodium sulphate as directed by Parrish *et al* and using Soxhlet apparatus and ethyl ether for extraction.

RESULTS AND DISCUSSION

Composition of colostrum during the successive periods for cows and buffaloes

The composition of the colostrum varied considerably in the *2nd* period than in the first period in both species particularly in dry matter content and protein (Table 1 & 2). The composition of milk during the *2nd* period was very approaching that of the third period which contained a little less dry matter and protein contnet. The colostrum of the third period was practically having the same composition as the whole milk of each species. The fat percentage and soluble carbohydrates in cow's milk remained the same or slightly increased in the last period while ash decreased gradually. With buffaloes, the fat percentage increased slightly in the *2nd* period and then decreased slightly in the *3rd* while the soluble carbohydrates seemed to increase while ash decreased in the successive periods.

With the individual samples great variation occurred in milk nutrients particularly in the *lst* and *2nd* period with the dry matter and protein. With cows in the *lst* period, the ranges of nutrients were 17.27-21.85, 6.11 - 14.21, 3.28 - 5.78, 3.50 - 4,44, 0.76 - 0.93 with dry matter, protein fat, soluble carbohydrates and ash respectively. The respective data for buffaloe's colostrum were 20.13 - 24.94., 8.86 14.83, 4.77 - 8.67, 3.72 - 4.20 and 0.91 - 1.07 (Tables 1 &2). In the *2nd* period the ranges of dry matter, protein, fat and carbohydrates were 13.92 - 15.94, 4.13 - 8.15, 2.65 - 4.83 and 2.41 - 4.86 with cows

being 15.75 - 20.33, 5.38 - 6.91, 4.97 - 8.43 and 3.75 - 5.35 with buffaloes. The respective ranges of these nutrients in the last period were 11.46- 14.17, 3.30 - 4.93, 3.65 - 4.95 and 3.30 - 4.75 with cows and 16.03 - 18.54, 4.98 - 5.52, 5.38 - 7.00 and 4.33 - 5.29 with buffalloes, being approaching the range of composition of the whole milk. The analytical results were within the ranges published in the literature with few exception perhaps due to normal variations.

TABLE 1.—**The average analysis, digestion coefficients and feeding value of cow's colostrum fed to their young claves in digestion trials using 7 claves and their mothers duruing 3 sccessive periods**

Item	Moisture	Dry Matter	Protein	Fat	Soluble Carbohydrates	Ash	Total Digestible Nutrients	Starch Value
Period 1 (0 to 2 days)								
Average analysis as fed and feeding value . . .	81.30	18.70	10.00	4.01	3.82	0.87	22.4	22.5
Minimum	78.15	17.27	6.11	3.28	3.50	0.76	18.9	19.2
Maximum.	82.73	21.85	14.21	5.78	4.44	0.93	24.9	24.9
Average analysis, dry and feeding value	—	100.00	53.48	21.44	20.43	4.65	119.8	120.1
Average digestion coef . .	—	97.80	96.80	99.10	99.10	—	—	—
Average digestible nutrients as fed	—	—	9.68	3.99	3.79	—	—	—
Period 2 (3 to 5 days)								
Average analysis as fed and feeding value . . .	85.73	14.27	5.66	4.00	3.80	0.81	17.9	18.2
Minimum	84.06	13.22	4.13	2.65	2.41	0.77	15.8	15.9
Maximum.	86.78	15.94	8.15	4.83	4.86	0.85	20.4	20.7
Average analysis, dry and feeding value	—	100.00	39.66	28.03	26.63	5.68	125.4	127.5
Av. digestion coefficients	—	96.10	91.90	98.40	98.30	—	—	—
Av. digestible nutrients .	—	—	5.20	3.94	3.73	—	—	—
Period 3. (6 to 8 days)								
Average analysis as fed and feeding value . . .	86.90	13.10	3.90	4.31	4.11	0.78	17.1	17.6
Minimum	85.83	11.46	3.30	3.65	3.30	0.76	14.7	15.1
Maximum.	88.54	14.17	4.93	4.95	4.75	0.84	18.9	19.2
Average analysis dry and feeding value	—	100.00	29.77	32.90	31.38	5.95	130.5	134.4
Av. digestion coefficients .	—	95.90	90.80	98.20	98.00	—	—	—
Av. digestible nutrients as fed	—	—	3.74	3.91	4.03	—	—	—

TALE 2.—The average analysis, digestion coefficients and feeding value of buffaloe's colostrum fed to their young calves in digestion trials using 6 calves and their mothers during 3 successive periods.

Item	Moisture	Dry Matter	Protein	Fat	Soluble Carbohydrates	Ash	T. D. N.	S. V.
Period 1 (0 to 2 days)								
Average analysis as fed and feeding value . .	77.63	22.37	10.86	6.54	3.97	1.00	28.76	29.15
Minimum	75.06	20.13	8.86	4.77	3.72	0.91	24.46	24.61
Maximum	79.87	24.94	14.83	8.67	4.20	1.07	32.84	33.60
Average analysis, dry and feeding value . . .	—	100.0	48.55	29.24	17.74	4.47	128.56	130.31
Av. digestion coefficients	—	97.10	95.90	97.90	98.90	—	—	—
Average digestible nutrients as fed	—	—	10.42	6.41	3.93	—	—	—
Period 2 (3 to 5 days)								
Average analysis as fed and feeding value . .	82.03	17.97	5.89	6.74	4.41	0.93	24.60	25.32
Minimum	79.67	15.75	5.38	4.97	3.75	0.85	20.77	21.25
Maximum.	84.25	20.33	6.91	8.43	5.35	0.97	29.46	30.40
Average analysis, dry and feeding valve	—	100.00	32.78	37.51	24.53	5.18	136.89	140.90
Av. digestion coefficients	—	96.00	92.50	98.00	97.30	—	—	—
Average digestible nutrients as fed	—	—	5.45	6.60	4.29	—	—	—
Period 3 (6 to 8 days)								
Average analysis as fed and feeding value . .	82.93	17.07	5.21	6.15	4.84	0.87	23.01	23.83
Minimum	81.46	16.03	4.98	5.38	4.33	0.83	21.47	21.99
Maximum.	83.97	18.54	5.52	7.00	5.29	0.92	25.72	26.52
Average analysis, dry and feeding value	—	100.00	30.52	36.03	28.35	5.10	134.80	139.60
Av. digestion coefficients	—	96.40	93.70	98.0	98.2	—	—	—
Average digestible nutrients as fed	—	—	4.88	6.03	4.75	—	—	—

Digestion coefficients and feeding value with colostrum during the successive periods with cows and buffaloes

The nutrients of the colostrum are highly digested in all the periods with both species. Fat and soluble carbohydrates were digested to the extent of 98- 99% in successive periods being not lower than

97%. The dry matter was digested to an extent of 96 - 98%. Protein was highly digested in the first period (96-97%). then a noticeable fall in digestion (ca. 3-5 degrees of percentage) occurred becoming 92% in the *2nd* period and 91-94% in the *3rd* period. The trend of results and magnitude was practically similar in both species.

TABLE 3.—**Variations in apparent digestion coefficients of colostrum nutrients using digestibility trials with buffalo and cow calves during three successive periods**

Item	Buffalo				Cow			
	Dry matetr	Protein	Fat	Soluble carbohydrates	Dry matter	Protein	Fat	Soluble carbohydrates
Period 1 (from 0 to 2 days)								
Average digestion coefficients (6)*	97.1	95.9	97.9	98.9	97.8	96.8	99.1	99.1
Minimum	97.0	95.3	97.4	98.3	96.6	95.8	98.4	98.5
Maximum	97.4	96.1	99.1	99.3	98.8	98.2	99.6	99.7
Standard error of the mean	±0.06	±0.13	±0.28	±0.27	±0.27	±0.35	±0.16	±0.47
Period 2 (from 3 to 5 days)								
Average digestion coefficients (6)*	96.0	92.5	98.0	97.3	96.1	91.9	98.4	98.3
Minimum	92.8	84.1	96.5	94.6	94.3	86.2	97.0	96.7
Maximum	98.7	97.1	99.4	99.8	97.6	97.4	99.6	99.5
Standard error of the mean	±0.95	±2.19	±0.47	±0.68	±0.52	±1.58	±0.36	±0.41
Period 3 (from 6 to 8 days)								
Average digestion coefficients (6)*	96.4	93.7	98.0	98.2	95.9	90.8	98.2	98.0
Minimum	95.2	91.4	94.7	97.5	93.8	86.7	97.2	96.8
Maximum	98.2	96.5	99.4	98.7	97.5	93.6	99.3	99.7
Standard error of the mean	±0.49	±0.72	±0.66	±0.18	±0.47	±0.96	±0.31	±0.39

* Six calves.

Statistical analysis indicated that there was no significant differences between the digestion coefficients for nutrients in the two species at comparable periods. But the average digestion coefficients of dry matter and protein at the first period was significantly higher than with those in the *2nd* or *3rd* period in both species. Taking the

average of results with cows and buffaloes, the digestion coefficients could be taken as 95.5, 96.4, 98.5 and 99 for dry matter, protein fat and carbohydrates in the *1st* period. After the *1st* period, the respective average coefficients would be 96.2, 92.2, 98.2 and 98 being similar to results already obtained with whole milk in a previous paper.

The digestion coefficients obtained here were 2-3 degrees of percentage higher than those published by Parrish *et al* (9) for fat and soluble-carbohydrates. With protein their figures were four degrees less in the first period and ca. 6 and 9 degrees less in the *2nd* and *3rd* period respectively.

The range of digestion coefficients among different calves was narrow in most cases, the highest range was with protein during the *2nd* and *3rd* period but nevertheless the coefficient of variation percentage was not exceeding 5.80.

The average feeding value with colostrum was the highest at the *1st* period being 29.15 starch value in buffaloes and 22.5 starch value in cows. In the *2nd* period a noticeable drop occurred in feeding value to become 25.32 and 18.2 respectively. A slight drop happened in the *3rd* period to become 23.83 and 17.6 starch value, being the same as with whole milk. Buffaloes colostrum had 30, 39 and 35% more starch value than cow's in the three sucessive periods; it contained also slightly more digestible protein. The digestible protein fell very rapidly from ca. 10% in the first period to become ca. 5 with buffalos and 3.9 with cows at the last period.

The average feeding value on dry matter basis increased with advancing periods with cows being 120.1, 127.5 and 134.4 starch value successively. With buffaloes, the respective feeding value was 130.3 140.9 and 139.6 being lower at the start and practically the same in the *2nd* and *3rd* period.

Buffaloe's dry colostrum contained 8.5, 10.6 and 3.9% more starch value in the respective periods. Therefore, while ca. 3 parts of buffaloe's colostum as fed would equals 4 parts of that of cow's, yet on dry matter basis they approached one another in feeding value particularly at the *3rd* period.

A relatively wide range of the feeding value was obtaind among individual calves as each one was fed different colostrum sample which varied in composition. The range in the feeding value was 19.2 - 24.9, 16.2 - 20.7 and 15.1 - 19.2 starch value with cows *1st*, *2nd* and *3rd* period respectively against 24.6 - 33.6, 21.3 - 30.4 and 22.0 26.5 with buffaloes.

These studies indicated clearly that the colostrum could be digested to the same extent with calves as ordinary whole milk. Colostrum, in the 1*st* two days, has a feeding value higer than whole milk and practically slightly higher or equal value to normal milk afterwards.

Therefore, colostrum would replace the whole milk if it is available to save a part of it in practical feeding.

ACKNOWLEDGEMENT

The authors wish to thank Dr. Abbas El-Itriby, General Director of the Animal Production Dept., Ministry of Agriculture, Dokki, for his deep interest in the subject and furnishing the facilities. Thanks are also to Mr. Abdel Rahman Moustafa, Director of the Experiment Stations at Sakha and Mehallet Moussa, for his cooperation and to Mr. Saad Emara Mr. Abdel-Kader Hamroush and other Agriculture Engineers in charge at these stations for their assistance.

REFERENCES

1. **A.O.A.C.** (1955).—Official Methods of Analysis. *8th Ed. Washington, D.C.*
2. **Castle, M.E. and Watson, J. N. A.** (1959).—Comarpison between an early and a more conventional system of rearing dairy calves.*Animal Prod.* **1** : 31 - 36.
3. **El-Negoumy, A. M.** (1957).—Properties and composition of colostrum from Egyptian buffaloes and cows. *J. Dairy Research,* **24** - 115.
4. **Ghoneim, A.** (1950). —Animal Nutrion. *5th Ed. Anglo Egyptian Liberary, Cairo* (in Arabic).
5. **Keaser, H.E. and Sutton, T.S.** (1954).—Benefical effects and economic importance of using all colostrum produced in calf raising *J. Dairy Sci.,* **31** : 523.
6. **Keyes, E.A., Peace, E.J. and Brence, J.L.** (1954).—The utilization of all the colostrum produced by a dairy herd for feeding the calves. *J. Dairy Sci.,* **37** : 655.
7. **Murley, W.R., Denton, T.W. and Waugh, R.K.** (1957).—A comparison of systems of feeding milk - replacement formulae to dairy calves . *J. Dairy Sci.,* **40** : 1258.
8. **Preston, T.R.** (1957).—Milk substitutes and early weaning of calves. *Agiculture, J. Minist., Res. Inst. Engl.,* **64** : 429 - 433.
9. **Parrish, D.B., Bartley, E.E., Burris, D.U. and McIntyre, R.I.** (1953).—Properties of colostrum of the dairy cow. 8. digestibility of colostrum and milk by calves during the early postnatal days of life. *J. Dairy Sci.,* **36** : 489 - 494.
10. **Quayle, P.D.** (1958).—A study of the effects of dietary auromycin and methods of weaning in early weaned calves. *J. Agric. Sci.* **50** : 335 - 339.
11. **Snedecor, G.W.** (1956).—Statistical Methods. *5th Ed Iowa State Colledge Press, Ames., Iowa, U.S.A.*

(Printed in 1966)

القيمة الغذائية للبن والسرسوب المغذى لعجول الجاموس الصغيرة

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الملخص

أجريت تجربة هضم على ٧ عجول بقرى ، ٦ عجول جاموسى عقب الميلاد مباشرة وقد قسمت فترة السرسوب الى ٣ فترات من صفر – ٢ يوم ، ٣ – ٥ يوم ، ٦ – ٨ يوم وغذى كل عجل من لبن أمه خلال هذه الفترات واستعمل مادة كارمين Carmine كمرقم للبراز لمعرفة ابتداء وانتهاء كل فترة من هذه الفترات . وغذيت العجول بواسطة البزازة واخذت عينات ممثلة للبن المغذى فى كل فترة وحفظ بالفورمالين بنسبة ١ : ١٠٠٠ كما جمع روث كل فترة على حدة وحفظت فى الثلاجة وقد وجد أن معاملات الهضم للبروتين والدهن والكربوهيدرات فى حالة العجـول البقرى فى الفترات الثلاث هى كالآتى على الترتيب :

٩٧ ، ٩٩ ، ٩٩ ثم ٩٢ ، ٩٨ ، ٩٨ ثم ٩١ ، ٩٨ ، ٩٨ فى الفترة الأولى والثانية والثالثة وكانت معاملات الهضم للعجول الجاموسى ٩٦ ، ٩٨ ، ٩٩ ثم ٩٣ ، ٩٨ ، ٩٧ ثم ٩٤ ، ٩٨ ، ٩٨ على التوالى أيضا فى الفترة الأولى والثانية والثالثة .

وأما القيمة الغذائية كمركبات مهضومة للسرسوب البقرى الطازج فى الثلاث فترات فكانت ٢٢ ، ١٨ ، ١٧ على التوالى ايضا . وانها فى حالة السرسوب الجاموسى الطازج فى الثلاث فترات كانت ٢٩ ، ٢٥ ، ٢٣ على التوالى ايضا .

وفى حالة السرسوب البقرى على الحالة الجافة تماما فى الفترات الثلاث كانت القيمة الغذائيـة ١٢٠ ، ١٢٥ ، ١٣١ وبالنسبة للعجـول الجاموسى كانت ١٢٩ ، ١٣٧ ، ١٣٥ على التوالى ايضا وان معادل النشا للسرسوب البقرى الطازج للفترات الثلاث كان ٢٣ ، ١٨ ، ١٨ . وكان معادل النشا للسرسوب الجاموسى الطازج للفترات الثلاث ٢٩ ، ٢٥ ، ٢٤ .

وكما وجد ان معادل النشا للبن البقرى فى الحالة الجافة تماما ١٢٠ ، ١٢٨ ، ١٣٤ فى الفترات الثلاث وكان بالنسبة للعجول الجاموسى ١٣٠ ، ١٤١ ، ١٤٠ على التوالى ايضا ويلاحظ ان القيمة الغذائية كمركبات مهضومة كلية أو كمعادل نشا تتساويان رقميا من الناحية العملية .