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GROWTH PERFORMANCE, DIGESTIBILITY COEFFICIENTS AND FEED EFFICIENCY OF SUCKLING CALVES AS AFFECTED BY EARLY WEANING SYSTEM AND ANTIBIOTICS SUPPLEMENTATION.

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ABSTRACT

Effect of early weaning for 45 days and early weaning with antibiotic supplementation on feed intake, nutrient digestibility coefficients, growth performance, feed efficiency and economic efficiency of Brown Swiss calves was studied as compared to normal weaning on 122 days of age. A total of 45 calves was assigned to three similar groups, 15 in each. Calves in the control group (G1) were fed whole cow's milk, calf starter and berseem hay (BH) and weaned on 122 days of age. The 2nd group (G2) was fed lower amount of whole cow's milk, higher amount of starter and BH and early weaned on 45 days of age. While, the 3rd group (G3) was fed the same diet of G2, but their milk was supplemented with 50 mg antibiotic (oxytetracyclin)/ kg milk and early weaned on 45 days of age. Results revealed that from birth to 45 days of age, total DM intake increased, while TDN and DCP intakes decreased in G2 and G3 as compared to G1. From birth to 122 days of age, total DM, TDN and DCP intakes decreased in G2 and G3 as compared to G1. At 45 days of age, digestibility coefficient of DM decreased ($P<0.05$) in G3 and of EE increased ($P<0.05$) in G2 as compared to G1 Digestibility coefficients of CP, CF and NFE did not differ significantly in G2 and G3 from G1. At 122 days of age, digestibility coefficients of DM decreased ($P<0.05$) and of CF increased ($P<0.05$) in G3 as compared to G1. While only digestibility of NFE was higher ($P<0.05$) in G2 than G1. The differences in digestibility coefficients of CP and EE between each of G2 and G3 from one side and G1 from the other side were not significant. At 45 days of age, averages LBW were lower ($P<0.05$) by about 9.5 and 6.8% in G2 and G3 than in G1, respectively. At 122 days of age, the differences in LBW among all groups were not significant. From birth to 45 days of age, total weight gain was higher ($P<0.05$) in G1 and G3 (20.8 and 19.3 kg, respectively) than in G2 (15.9 kg). From birth up to 122 days of age, these differences were not significance and LBW ranged between 55.1 and 57.1 kg. The differences in average daily gain were not significant from birth to 45 or to 122 days of age. From birth to 45 days of age, feed efficiency (g gain/kg DM) was lower ($P<0.05$) in G2 and G3 than in G1, being the lowest ($P<0.05$) in G2, and as g gain/kg TDN and DCP was higher ($P<0.05$) in G1 and G3 than in G2. From birth to 122 days of age, the differences in feed efficiency (g gain/kg DM and DCP) were not significant, and as g gain/kg TDN was higher ($P<0.05$) in G2 and G3 than in G1. Calves in G3 showed the highest economic efficiency from birth to 45 days of age, while G2 showed the highest economic efficiency from birth to 122 days of age.

Based on the forgoing results, it could be concluded that weaning the suckling calves on 45 days of age with antibiotic supplementation (50 mg tetracycline/ kg milk) has beneficial effects on their growth performance, digestibility coefficients and economic feed efficiency either with or without antibiotics.

Keywords: Suckling calves, Antibiotics, digestibility, feed efficiency.

INTRODUCTION

Restriction of the consumption of dam's milk in early weaning regimens is one of many management strategies to reduce rearing cost of suckling calves (Ragheb, 2003). Restriction of milk consumption and increasing solid feeds supplemented with antibiotics may enhance the digestion and absorption efficiency of the intestinal wall (Quigley *et al.*, 1997).

Supplemental antibiotic agents have been reported to decrease intestinal microbial growth in chickens (Shaddad *et al.*, 1985) and calves (Jenny *et al.*, 1991; Quigley *et al.*, 1997; Donovan *et al.*, 2002). Yuangklanga *et al.* (2005) hypothesized that supplemental antibiotics would stimulate fat digestion in veal calves through inhibition of bacterial deconjugation of bile acids in the small intestine.

Antibiotics have been shown to improve nutrient utilization in animals. Visek (1978) proposed that antibiotics might enhance the digestion and absorption efficiency of the intestinal wall. No available data were reported on the effect of antibiotics on performance of early-weaned Brown Swiss calves in Egypt.

Therefore, the current work was carried out to evaluate the effects of dietary supplementation of antibiotics and/or early weaning system on growth performance, digestibility coefficients, and feed and economic efficiencies of suckling Brown Swiss calves.

MATERIALS AND METHODS

Animals and feeding system:

This study was carried out at Salhaia Dairy Station. A total of 45 newly born Brown Swiss calves was divided into three similar groups, 15 calves in each according to their birth weights.

After birth, calves in all groups were left to suckle colostrum from their dams for 3-4 days, thereafter they were artificially suckled fresh whole cow's milk iwice daily (7 a.m. and 4 p.m.) until weaning period of 122 days in control group (G1) and 45 days of age in both G2 and G3. At the beginning of the 2nd wk of age, calves in the 1st group (control, G1) and the 2nd group (G2) were fed whole cow's milk. However, calves in the 3rd group (G3) were suckled fresh whole cow's milk supplemented with antibiotics 50 mg/kg milk. Calves in the control group were weaned at about 122 days, while those in G2 and G3 were early weaned at 45 days of age. All groups were fed starter and berseem hay (BH).

Average daily intake of different feedstuffs offered to each calf according to requirements of NRC (1988) for suckling calves is presented in table (1). Calf starter was composed of 15% decorticated cotton seed cake; 15% line seed meal; 40% yellow corn; 15% wheat bran; 11.5% rice bran; 2% limestone; 1% common salt and 0.5% vitamins AD_3E. Chemical composition of feedstuffs used in calves feeding is presented in Table (2). Fresh water was available for all calves all daytime.

Experimental procedures:

Throughout the experimental period, individual live body weight (LBW) was weekly recorded, then total weight gain (TWG) and average daily gain (ADG) were also calculated. Chemical analysis of feeds and feces were determined according to A.O.A.C. (1984), however milk composition was determined using milko-scan. In addition, economic and feed efficiencies were performed at 45 and 122 days of age.

Table (1): Average daily amount of feedstuffs offered to each calf.

Age (wk)	Feedstuff					
	Milk (l)		Starter (g)		BH (g)	
	Control	Tested	Control	Tested	Control	Tested
1-3 days	Colostrum		-		-	
4-7 days	4	4	-		-	
2	4	3	100	100	50	50
3	5	3	150	250	50	100
4	5	3	200	350	100	150
5	5	2	300	500	100	250
6	4	2	400	700	150	350
7	4	1	500	900	200	450
8	4	-	600	1100	250	550
9	3	-	800	1300	300	650
10	3	-	1200	1500	350	750
11	3	-	1400	1500	400	1000
12	2	-	1500	1600	500	1000
13	2	-	1500	1700	600	1250
14	1	-	1500	1750	700	1250
15	1	-	1500	1800	750	1500
16	1	-	1600	1900	850	1600
17	0.5	-	1700	2000	950	1700
18	0.5	-	1800	2000	1000	1700

Table (2): Chemical analysis of different feedstuffs.

Feed stuff	DM%	Chemical composition on DM basis, %					Nutritive value (%)	
		CP	CF	EE	NFE	Ash	TDN	DCP
Feed stuffs:								
Milk	12.32	26.20	-	32.32	35.37	6.11	17.20	3.10
Starter	90.12	21.35	5.28	6.53	61.72	5.12	71.36	16.14
BH	89.20	14.74	29.33	3.71	40.08	12.14	48.00	9.00

Digestibility trials:

At early weaning of the control group of G2 and G3 (45 days) and at normal weaning age of the control group (122 days), digestion trials were conducted using individual metabolic cages and three calves from each

group. Fecal were punitively collected from each calf per day for 5 days to determine digestibility coefficients of nutrients of calves of each group.

Statistical analysis:

The statistical analysis of the obtained data was performed as a complete design using the least square means described by Likelihood programme of SAS (1987). The significance of group differences was carried out according to Duncan's Multiple Range Test (1955).

RESULTS AND DISCUSSION

Feed intake:

Averages daily intake of different feedstuffs offered to each calf are presented in table (3). During the interval of early weaning from birth to 45 days of age, level of starter and BH as DM intakes increased in G2 and G3 by about 64 and 105% than in the control group (G1), respectively. However, level of milk intake decreased by about 39% in G2 and G3 than in G1. This was reflected in slightly higher total DM intake in G2 and G3 (884 g/h/d, in each) than in the control one (801 g/h/d). The intake as TDN and DCP from milk markedly decreased and from each of starter and BH increased in both G2 and G3 as compared to the control group (G1). Such trend resulted in higher total intake as TDN and DCP in G1 than in G2 and G3 (Table 3).

During the interval of normal weaning from birth to 122 days of age, feed intakes as DM, TDN and DCP (g/h/d) markedly increased in G1 as compared to G2 and G3 (Table 3).

Table (3): Average daily feed intake as DM, TDN and DCP of calves at different ages as affected by early weaning and Antibiotics supplementation.

Item	G1		G2		G3	
	Birth-45 days	Birth-122 days	Birth-45 days	Birth-122 days	Birth-45 days	Birth-122 days
Average daily DM intake (g/h/d):						
Milk	455	345	277	103	277	101
Starter	248	793	406	816	406	802
Berseem hay	98	366	201	505	201	497
Total	801	1504	884	1424	884	1400
Average daily TDN intake (g/h/d);						
Milk	635	482	387	144	387	141
Starter	196	628	321	646	321	635
Berseem hay	78	197	108	272	108	267
Total	909	1307	816	1062	818	1043
Average daily DCP intake (g/h/d);						
Milk	114	87	70	26	70	25
Starter	44	142	73	146	73	144
Berseem hay	18	37	20	51	20	50
Total	176	266	163	223	163	219

These results indicated that from birth to 45 days of age, total DM intake increased and TDN and DCP intakes decreased in G2 and G3 as compared to G1. From birth to 122 days of age, total DM, TDN and DCP intakes decreased in G2 and G3 as compared to G1 (Table 3).

It is obvious that these differences were related to the weaning management regimen rather than antibiotics supplementation. Feed intake as total DM, TDN and DCP was nearly similar for G2 and G3. Similar trends of feed intakes were obtained by Ragheb (2003) on suckling calves under early weaning system and yeast culture supplementation

Nutrient digestibility coefficients:

At 45 days of age, digestibility coefficient of DM significantly ($P<0.05$) decreased in G3 and digestibility coefficient of EE significantly ($P<0.05$) increased in G2 as compared to the control (G1). However, digestibility coefficients of CP, CF and NFE did not differ significantly in G2 and G3 from those in the control group (G1). Digestibility coefficients of DM and CP significantly ($P<0.05$) decreased and digestibility coefficient of CF significantly ($P<0.05$) increased in G3 as compared to G2. While, digestibility coefficients of EE and NFE did not differ significantly between G2 and G3 (Table 4).

At 122 days of age, digestibility coefficients of DM significantly ($P<0.05$) decreased in G3 compared with G1 and digestibility coefficients of CF in G3 and of NFE in G2 significantly ($P<0.05$) increased as compared to the control (G1). However, digestibility coefficients of DM and NFE were significantly ($P<0.05$) lower and those of CP and CF were significantly ($P<0.05$) higher in G3 than G2. The differences in digestibility coefficients of EE among all groups were not significant.

It is of interest to note that with advancing age of calves in G2 and G3 up to 122 days, digestibility coefficients of DM and EE showed similar trend to that at 45 days of age. However, digestibility of CP and CF showed an opposite trend in both groups at 45 and 122 days of age.

Table (4): Digestibility coefficient (%) by calves at different ages in different experimental groups.

Item	Digestibility coefficient (%)				
	DM	CP	CF	EE	NFE
At 45 days of age:					
Control (G1)	86.7^{a}	87.5^{ab}	43.4^{ab}	83.0^{b}	90.6
G2	86.0^{a}	89.4^{a}	42.7^{b}	86.7^{a}	90.1
G3	84.5^{b}	86.6^{b}	45.7^{a}	85.0^{ab}	89.3
±SEM	0.67	1.02	0.93	1.09	0.97
At 122 days of age:					
Control (G1)	83.4^{a}	82.1^{ab}	60.3^{b}	90.9	87.3^{b}
G2	82.8^{a}	80.6^{b}	61.3^{b}	90.5	91.4^{a}
G3	80.5^{b}	84.8^{a}	66.4^{a}	91.9	88.1^{b}
±SEM	0.78	1.18	1.72	1.12	0.87

a and b: Means denoted with different superscripts within the same column for each age are significantly different at $P<0.05$.

Interestingly to note that the significant increase in digestion of CP and CF in G3 as compared to G2 at 122 days of age may indicate beneficial effects of adding antibiotics in milk of suckling calves under early weaning system. Such trend may indicate some improvement of antibiotics on rumen fermentation. On the other hand, the marked increase in digestion of CP and CF at 122 than 45 days of age may be related to the advanced development, anatomically, histologically and functionally in rumen of calves by advancing age (Abdel-Khalek *et al.*, 2000).

The observed increase in CF digestion of calves in G3 at both ages studied as compared to the control groups was in accordance with the results of Ragheb (2003) under early weaning system and yeast cultur supplementation

Supplemental antibiotic agents have been reported to decrease intestinal microbial growth in chickens (Shaddad *et al.*, 1985) and calves (Jenny *et al.*, 1991; Quigley *et al.*, 1997; Donovan *et al.*, 2002). Yuangklanga *et al.* (2005) hypothesized that supplemental antibiotics would stimulate fat digestion in veal calves through inhibition of bacterial deconjugation of bile acids in the small intestine. Because fat digestion and fecal bile acid excretion are negatively correlated (Xu *et al.*, 1998).

Growth performance:

At end of the early weaning period (45 days of age), averages of final live body weight was significantly ($P<0.05$) lower by about 9.5 and 6.8% in G2 and G3 than the control (G1), respectively. However, at end of the normal period of weaning (122 days of age), averages of final live body weight did not differ significantly in G2 and G3 from that in the control group (G1). Generally, LBW of calves in all groups ranged between 93.2 and 96.9 kg, which was within the normal LBW of calves at normal weaning (85-95 kg, Ragheb, 2003 and Abdel-Khalek *et al.*, 2000).

From birth to 45 days of age, total weight gain was significantly ($P<0.05$) higher in G1 and G3 (20.8 and 19.3 kg, respectively) than in G2 (15.9 kg), although the initial weights of calves in G3 were lower than those in the control (36.3 vs. 39.0 kg). From birth up to 122 days of age the differences among groups were not significant at $P<0.05$, and values of total gain ranged between 55.1 and 57.1 kg.

Concerning average daily gain, it was observed that the differences among the three groups were not significant either at 45 or 122 days of age, being almost the highest in the control (G1), moderate in G3 and the lowest in G2.

Based on the results of growth performance, early weaning of calves with antibiotic supplementation achieved nearly results of the control group, with saving a considerable amount of milk for human consumption and slight increase in total DM intake. Nearly similar result was obtained by Ragheb (2003).

Feed efficiency:

Regarding the feed efficiency from birth to 45 days of age (table 5), calves in G2 and G3 showed significantly ($P<0.05$) lower feed efficiency as total DM than the control group, being significantly ($P<0.05$) the lowest in G2. However, feed efficiency as TDN and DCP was significantly ($P<0.05$) lower in G1 and G3 than in G2. Such differences were mainly related to lower amount of feed intake from milk in G2 and G3 than that in the control (G1) as affected by early weaning system (Ragheb, 2003)

From birth to 122 days of age, feed efficiency, as total DM and DCP did not differ significantly among all groups. However, feed efficiency as TDN was significantly ($P<0.05$) higher in G2 and G3 than in the control group (G1). in term of gain (g) per kg total DM, TDN and DCP (Table 5),

The significantly higher feed efficiency as TDN in G2 and G3 may be associated with an improvement in digestion of CF and NFE as compared to the control group (G1).

Economic efficiency:

Data in table (6) revealed that daily feed cost of each calf from birth to 45 days was higher in the control group (G1) than in G2 and G3 by 46.4 and 39.2%, respectively, as a result of increasing the amount of milk and slightly higher in G3 than in G2 by 6% due to the cost of the supplemented antibiotic. This trend was more pronounced as daily feed cost of each calf from birth to 122 days. The corresponding increase was 105.3 and 93.7, respectively.

In spite the tendency of higher ADG in the control group (G1) than in G2 and G3 from birth to 45 days was associated with higher daily feed cost, resulting in higher daily feed cost per kg gain in G1 than G2 and G3 by 17 and 28%, respectively. From birth to 122 days, marked reduction in daily feed cost had occurred in G2 and G3 as compared to the control group in association with lowering daily feed cost per kg gain by 48.6 and 46 6% in G2 and G3 as compared to the G1, respectively (Table 5).

Generally, early weaned calves without supplementation in G2 showed the lowest daily feed cost per kg gain, followed by those early weaned with antibiotic supplementation in G3, while the control calves showed the highest cost.

Based on the forgoing results, it could be concluded that early weaning of suckling calves on 45 days of age with or without antibiotic supplementation has beneficial effects on their growth performance, digestibility coefficients, feed efficiency and economic efficiency.

Table (5): Growth performance and feed efficiency of calves at different ages as affected by early weaning and Antibiotics supplementation.

Item	G1		G2		G3	
	Birth- 45 d	Birth- 122 d	Birth- 45 d	Birth- 122 d	Birth- 45 d	Birth- 122 d
Growth performance:						
Number of calves	15	15	15	15	15	15
Initial weight (kg)	39.0±1.2	39.0±1.30	38.2±0.64	38 1±1.35	36.3±1.2	36.3±1.3
Final weight (kg)	59.8±1.04^{a}	96.9±2.35	54.1±1.46^{b}	93.2±1.70	55.7±1.46^{b}	93.4±1.74
Total weight gain (kg)	20.8±1.40^{a}	57.9±1.3	15.9±1.53^{b}	55.1±1.7	19.3±1.7^{a}	57.1±1.5
Average daily gain (g)	458±2.50	480±17.2	366±27.0	455±22.6	421±2.43	464±27.7
Feed efficiency (Gain (g)/kg):						
Total DM	572^{a}	319	414^{c}	320	476^{b}	331
TDN	504^{a}	367^{B}	449^{b}	428^{A}	516^{a}	445^{A}
DCP	2602^{a}	1805	2245^{b}	2040	2583^{a}	2119

A, b and c for 45 days interval and A & B for 122 days interval: Means denoted with different superscripts within the same row are significantly different at P<0.06).

Table (6): Economic efficiency of calves at different ages as affected by early weaning and Antibiotics supplementation.

Item	G1		G2		G3	
	Birth- 45 d	Birth- 122 d	Birth- 45 d	Birth- 122 d	Birth- 45 d	Birth- 122 d
Average daily feed cost (L.E.):						
Milk	5.535	4.200	3.375	1.253	3.375	1.232
Starter	0.33	1.056	0.540	1.086	0.540	1.068
Berseem hay	0.066	0.246	0.135	0.340	0.135	0.334
Antibiotics	-	-	-	-	0.21	0.21
Total daily cost (L.E./h)	5.931	5.502	4.050	2.679	4.260	2.840
Average daily gain (kg/h)	0.458	0.480	0 366	0.455	0.421	0.464
Cost of kg gain (L.E.)	12 95	11.46	11.07	5.89	10.12	6 12
Economic efficiency (%)	193.1	218.2	225.8	424.4	247.0	408.5

Market price of each kg from milk, starter and berseem hay were 1.5, 1.2 and 0.6 L.E, respectively.
Price of Antibiotic was 42 L.E/kg.

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معدل أداء النمو، معاملات الهضم والكفاءة الغذائية للعجول الرضيعة تحت تأثير نظام الفطام المبكر واضافة المضادات الحيوية.

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استخدم في هذه الدراسة ٤٥ عجل برون سويس بعد رضاعة السرسوب مباشرة- قسمت عشوائيا إلى ثلاث مجموعات متشابهة (١٥ عجل فى كل مجموعة) تبعا للوزن و الجنس حيث تم تغذية العجول في مجموعة المقارنة على علف بادئ و دريس برسيم بالإضافة إلى اللبن البقرى طوال فترة الرضاعة و حتى الفطام على عمر ١٢٢ يوم، أما عجول المجموعة الثانية فقد غذيت على كمية أقل من اللبن وكمية أكبر من البادئ ودريس البرسيم وتم فطاميا على عمر ٤٥ يوم، بينما عجول المجموعة الثالثة فقد غذيت على نفس علائق المجموعة الثانية ولكن أضيف إلى اللبن مضادات حيوية (تتراسيكلين بكميات أقل من الجرعات العلاجية، ٥٠ ملجم/كجم لبن). خلال الفترة التجريبية (من الميلاد وحتى ١٢٢ يوم) وتم تسجيل وزن الجسم والغذاء المأكول وعمل تجارب هضم و كذلك تم حساب الكفاءة الغذائية والكفاءة الاقتصادية عند عمر ٤٥ و١٢٢ يوم.

من هذه الدراسة تم استنتاج النتائج التالية:

١- خلال الفترة من الميلاد حتى عمر ٤٥ يوم زادت كمية المادة الجافة وانخفضت كمية TDN, DCP المأكول فى المجموعة الثانية و الثالثة عن المجموعة الأولى (المقارنة)، أما خلال الفترة من الميلاد حتى عمر ١٢٢ يوم انخفضت كمية المادة الجافة و TDN, DCP المأكول فى المجموعة الثانية و الثالثة عن المجموعة الأولى (المقارنة).

٢- خلال الفترة من الميلاد حتى عمر ٤٥ يوم انخفضت معاملات الهضم للمادة الجافة فى المجموعة الثالثة وارتفعت معاملات الهضم للمستخلص الأثيري فى المجموعة الثانية معنويا (عند مستوى ٥%) عن المجموعة المقارنة ،ولم تختلف معاملات هضم البروتين الخام، الألياف الخام و مستخلص خالي الأزوت معنويا (عند مستوى ٥%) فى المجموعة الثانية عن الثالثة، أما خلال الفترة من الميلاد حتى عمر ١٢٢ يوم انخفضت معاملات الهضم للمادة الجافة وارتفعت معاملات هضم الألياف الخام معنويا (عند مستوى ٥%) فى المجموعة الثالثة عن مجموعة المقارنة.

٣- عند عمر ٤٥ يوم انخفض وزن الجسم معنويا (عند مستوى ٥%) بمعدل ٩,٥% و٦,٨% فى المجموعة الثانية و الثالثة عن المجموعة الأولى (المقارنة) على الترتيب.)، أما عند عمر ١٢٢ يوم لم يتأثر الوزن معنويا.

٤- خلال الفترة من الميلاد حتى عمر ٤٥ يوم زاد معدل الوزن الكلى للعجول فى المجموعة الأولى والثالثة معنويا عن المجموعة الثانية. أما خلال الفترة من الميلاد حتى عمر ١٢٢ يوم لم يختلف معدل الوزن الكلى للعجول فى المجموعات معنويا.

٥- لم يختلف معدل النمو اليومي للعجول بين المجموعات معنويا (عند مستوى ٥%) خلال الفترة من الميلاد حتى عمر ٤٥ يوم أو خلال الفترة من الميلاد حتى عمر ١٢٢ يوم.

٦- خلال الفترة من الميلاد حتى عمر ٤٥ يوم انخفضت الكفاءة الغذائية للعجول (جم نمو /كجم مادة جافة) معنويا (عند مستوى ٥%) فى المجموعة الثانية و الثالثة عن المجموعة الأولى (المقارنة) و انخفضت الكفاءة الغذائية للعجول (جم نمو /كجم DCP, TDN) معنويا (عند مستوى ٥%) فى المجموعة الثانية عن الأولى والثالثة، أما خلال الفترة من الميلاد – عمر ١٢٢ يوم لم تختلف الكفاءة الغذائية للعجول (جم نمو /كجم مادة جافة أو DCP) معنويا (عند مستوى ٥%) بين المجموعات ولكن كانت الكفاءة الغذائية للعجول (جم نمو /كجم TDN) أعلى معنويا فى المجموعة الثانية و الثالثة عن المجموعة الأولى (المقارنة).

٧- أوضحت النتائج أن أعلى كفاءة غذائية واقتصادية كانت للعجول المغذاة لبن مضاف إلية تتراسيكلين (٥٠ محم/كجم) عند عمر ١٢٢ يوم عن العجول المقارنة المجموعة الثانية.

وبناء على هذة النتائج توصى الدراسة باضافة مضادات حيوية بكميات أقل من الكميات العلاجية (٥٠ محم تتراسيكلين /كجم لبن خلال فترة الرضاعة) والفطام المبكر عند عمر ٤٥ يوم.