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EFFECTS OF FEEDING WHOLE MILK, MILK REPLACER WITH OR WITHOUT CALF STARTER ON CALF PERFORMANCE AND SELECTED BLOOD METABOLITES

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ABSTRACT

The objectives of this feeding experiment were to evaluate effects of raising neonatal calves till weaning on different feeding regimes including whole milk (WM), milk replacer (MR), calf starter (CS) and concentrate mixture (CM) on growth performance (body weight, body weight gain, feed intake, body stature), fecal score and some blood metabolites as rumen development indicators of newborn calves. Twenty five Holstein newborn ♂ calves of almost equal body weight (average 40.3 kg) were divided from the first day of age into five equal groups and reared in separate wooden pens (5.5 m x 3 m) till weaning. Colostrum was fed for the first 3 days after birth, then the calves were switched over to the experimental feeding regime till 12th weeks (wk) of age. The calves in the first group fed on WM plus CM and good quality berseem hay till weaning. The second group fed on WM for 2 weeks, then replaced with MR plus CM and berseem hay till weaning. The used MR (Quality Milk®, Holland) contained 22% CP. The third group was offered WM plus CS and berseem hay till weaning. The calf starter was formulated to contain 20% CP. The fourth group fed on MR starting from the 5th d of age plus CS and hay till weaning. The fifth group was offered WM of 2 weeks followed by MR plus CS and hay till weaning. Concentrate intake, body weight, fecal score, body stature and selected serum metabolites were determined. At 12th wk of age, the calves groups received CS along with WM plus MR attained higher body weight (95.2 kg) than the calf-group fed WM or MR with CM (84.0 and 86.4 kg). Throughout the whole study, the fecal score was ranged from 2 to 2.14 for all groups and incidence of diarrhea was low. Regarding to the body stature, the calves fed WM+MR+CS had the highest body length, height and body depth than other groups. At 12th wk of age, calves fed only WM or WM+MR along with CM and hay had the lowest β-hydroxybutyrate value (0.308 and 0.362 mmol/L, respectively). However, blood glucose levels were higher for calves fed WM or WM+MR with CM (78.6 and 72.6 mg/dL, respectively) than other groups. In conclusion, it seems that raising neonatal calves on WM+MR+CS is the most suitable raising system regarding the body weight gain as well as body stature values and rumen developing followed by MR+CS system.
Keywords: Whole milk, milk replacer, calf starter, performance, calf

INTRODUCTION

The main goals of calves rearing systems are to improve performance and health (Drackley, 2008). Selecting the suitable raising system is the key factor to enhance the body weight (BW) gain with reducing the incidence of disease for neonatal calves. It is well known that feeding WM has a significant role in the growth and health of newborn calves, and it has positive effects on performance post-weaning (Moallem et al., 2010). Generally WM feeding to newborn calves is about 10% of BW/day. A milk replacer (MR) is used as an alternative to natural cow's milk by supplying the nutritional needs of the calf during the early critical stage of life, about 10% birth BW (Drackley et al., 2004). However, cost and availability will determine which liquid feed is used. Because of increasing cost of WM, MR is often the feed of choice due to their effectiveness (Drackley, 1999). According to previous researches, poor weight gain and higher risk of diseases during feeding WM and MR were reported (Jasper and Weary, 2002; Godden et al., 2005). Thus, it is worthy to note that offering high amounts of WM does not always improve BW, because of reducing calf starter (CS) intake and consequently impair rumen development (Khan et al., 2011). Moreover, the transition process from liquid feed to solid is demanding of nutritional requirements for neonatal calves (Weary et al., 2008). One of the main nutrient requirements for pre-weaned calves is protein. Therefore, the crude protein (CP) level in CS should be considered in addition to milk protein. National Research Council has recommended 18 % CP in CS feed on DM basis (Hill et al., 2008). However, Drackley et al. (2004) stated that calves fed CS of 22 % CP were more efficient than calves fed CS of 18 % CP.

Therefore, the present study was carried out to evaluate the effects of different raising systems including MR and/or experimental CS in comparison with WM and CM on growth performance, rumen development and health of newborn calves till the weaning.

MATERIALS AND METHODS

Animals and experimental design

Twenty five Holstein newborn calves reared in wooden pens (5.5 m x 3 m) from the first day of age till 12 wk. The newborn calves were distributed into five groups (each of 5 newborn calves) of nearly equal BW (40.3 kg). Each pen was divided into 5 separate parts with woody partition in between the calves to prevent direct contact. In each pen a platted rubber matt was placed on the concrete floor to function as bedding for the calves.

All calves were hand fed colostrums (2 L) after labour. Colostrum feeding was continued for the first 3 days of age birth and then the calves were switched over to the experimental five dietary regimes.

The first group fed on WM at 1/10 of calves birth BW (4 L/d) plus CM and good quality berseem hay were provided ad lib starting from the beginning of the 2nd wk till weaning. The second group fed on WM for 2 wk, then replaced with MR (1/10 of calves BW) in 2 meals plus CM and berseem hay till weaning. The third group fed on WM (1/10 of calves BW) plus CS offered at d 5 of age and berseem hay till weaning. The fourth group fed on MR starting from the 5th day of age at 1/10 of calves birth BW plus CS offered at d 5 of age and hay till weaning. The fifth group fed on WM for 2 wks followed by MR starting from the beginning of the 3rd wk at 1/10 of calves birth BW plus CS offered at d 5 of life and hay till weaning.

The used MR (Quality Milk®, Schils, 6136 GM Sittard, Holland) contained 22 % CP, 20 % EE and 9.5 % ash and diluted to 15 % in warm water.

Generally, water was available ad lib except for 30 minutes before and after WM feedings. Good leafy, greenish berseem hay and concentrate mixture of ground yellow corn and wheat bran (1:1) with common salt (0.5 %) was provided to calves ad lib starting from the beginning of the 2nd week of age for groups 1 and 2. The CS consisted of: 43 % yellow corn; 31 % SBM (48 % CP); 22.8 % wheat bran; 2.2 % lime stone; 0.5 % common salt and 0.5 % mineral and vitamin premix. The chemical composition of the CS revealed that DM 89.2 %; CP 20.3 %; EE 5.2 %; ash 3.8 %. The CM and CS intakes were measured daily.

Parameters measured

Calves were weighed at birth and thereafter every 4 wk until end of trial (12th wk of age) and BW gain were determined. Calves intake of CM and CS were measured daily for each calf group. The following body stature measurements of newborn calves were done every 6 wk.

(i) Shoulder height = measured at the highest point of the calf's withers.

(ii) Body length = measured straight from the shoulder joint to the hip joint.

(iii) Chest diameter = measured snug but not too tight around the heart girth just behind the front legs and shoulder blade.

(iv) Body depth = measured from just behind the front legs to the calf's withers.

All measurements were taken while the calves were standing comfortably on a clean, hard, level surface with their heads upright and looking forward (Bridges, 2009).

Fecal consistency

The fecal consistency was scored every morning before feeding. A scoring system was used from 1 to 4 (1= firm, well-formed feces; 2= soft pudding like feces; 3= runny pancake batter (beginning of diarrhea); 4= watery-liquid like substance feces that can be described as severe diarrhea) as described by Larson et al. (1977).

Blood samples and analytical procedures

Blood samples were collected (5 calves/group) every 6 weeks via jugular vein puncture. Blood was collected in 10 ml tubes containing potassium oxalate and sodium fluoride for glucose analysis and sodium heparin for plasma urea nitrogen (PUN) and β-hydroxybutyric acid (BHBA) analyses. The blood was centrifuged for 15 minutes at 3000 rpm, then plasma was collected and stored in deep freeze at -20 ºC until analyses.

Commercial spectrophotometric kits (Urea Nitrogen Berthelot/Colorimetric; Pointe Scientific, Inc., Canton, MI) were used for determination of PUN as described by Hayashi et al. (2006). For determination of plasma glucose concentration, commercial spectrophotometric kits (Glucose Oxidase) (Point Scientific, Inc., Canton, MI) were used (Quigley and Bernard, 1992). Commercial spectrophotometric kits (β-Hydroxybutyrate Liquicolor® Procedure No. 2440; STANBIO Laboratory, Boerne, Texas) were used for plasma BHBA concentration as described by Quigley et al. (1991).

Statistical analysis

The results were subjected to a one-way ANOVA to test the effects of different raising systems as milk replacer and/or experimental calf starter in comparison with whole milk on growth performance and health of newborn calves. Data were analyzed using statistical SPSS v20 (SPSS Inc., Chicago, IL, USA). Differences between dietary groups means were compared using Duncan's multiple range test.

Table 1: Body weight development (kg) for calves fed different experimental dietary regimes till weaning (Mean±SE)

	Treatments/groups				
	WM	**WM+MR**	**WM+CS**	**MR+CS**	**WM+MR+CS**
Experimental period (wk)					
0	40.2±3.49	40.8±1.64	39.8±0.78	40.2±1.09	40.8±1.48
4	51.2^{b}±2.68	52.0^{b}±3.30	53.6^{b}±2.50	55.6^{a}±1.40	55.4^{a}±2.98
8	66.0^{b}±4.38	64.8^{b}±3.27	72.8^{a}±3.35	72.4^{a}±3.11	73.0^{a}±3.36
12	84.0^{b}±4.62	86.4^{b}±2.30	91.6^{a}±2.07	92.8^{a}±2.25	95.2^{a}±4.72

$^{a.b}$ Means in the same row with different superscripts are significantly different ($p < 0.05$)
WM= whole milk; WM+MR= whole milk+milk replacer; WM+CS= whole milk+calf starter; MR+CS= milk replacer+calf starter; WM+MR+CS= whole milk+milk replacer+calf starter

Table 2: Body weight gain (kg) for neonatal calves fed different experimental dietary regimes till weaning (Mean±SE)

	Treatments/groups				
	WM	**WM+MR**	**WM+CS**	**MR+CS**	**WM+MR+CS**
Experimental period (wk)					
0-4	11.0^{c}±1.12	11.2^{c}±1.65	13.8^{b}±2.31	15.4^{a}±1.34	14.6^{a}±1.15
4-8	14.8^{c}±1.26	12.8^{d}±1.48	19.2^{a}±2.31	16.8^{b}±2.22	17.6^{b}±1.88
8-12	18.0^{c}±2.31	21.6^{a}±2.11	18.8^{c}±1.75	20.4^{b}±2.14	22.2^{a}±2.50
0-12	43.8^{b}±2.34	45.6^{b}±3.12	51.8^{a}±2.81	52.6^{a}±2.51	54.4^{a}±3.11

$^{a.b}$ Means in the same row with different superscripts are significantly different ($p < 0.05$)
WM= whole milk; WM+MR= whole milk+milk replacer; WM+CS= whole milk+calf starter; MR+CS= milk replacer+calf starter; WM+MR+CS= whole milk+milk replacer+calf starter

Table 3: Body stature measurements (cm) for neonatal calves receiving different experimental dietary regimes till weaning (Mean±SE)

	Treatments/groups				
	WM	**WM+MR**	**WM+CS**	**MR+CS**	**WM+MR+CS**
Length, wk					
0	89.2±0.84	89.6±1.14	89.4±0.89	89.8±0.84	90.0±0.7
6	94.6±0.89	95.4±1.82	97.4±2.07	99.0±2.55	100.4±2.6
12	100^{b} ±1.8	100^{b}±1.3	109^{ab}±2.59	115^{a}±2.77	118^{a}±2.78
Height, wk					
0	75.2±0.87	75.0±0.71	74.6±0.55	74.6±0.55	75±0.71
6	79.0±1.22	79.2±0.84	79.6±0.55	78.6±0.89	80.8±1.64
12	82.4^{b}±1.1	82.8^{b}±0.84	88.4^{a}±1.14	88.6^{a}±0.89	89.6^{a}±2.6
Heart girth, wk					
0	81.8±0.45	81.4±0.8	81.2±0.84	81.0±1.0	81.6±0.55
6	85.6±0.89	85.4±0.55	84.6±0.55	84.6±0.55	85.8±1.10
12	89.4±1.14	89.8±0.45	90.0±1.41	89.8±1.48	91.0±1.2
Body depth, wk					
0	29.8±0.84	30.0±0.71	29.2±1.3	29.2±1.3	29.4±0.89
6	32.8±0.84	33.8±1.3	34±1.52	34.2±1.64	34.6±1.14
12	36.4^{b}±0.8	37.2^{b}±1.12	40.6^{a}±0.52	40.8^{a}±1.5	41.6^{a}±0.8

$^{a.b}$ Means in the same row with different superscripts are significantly different ($p < 0.05$)
WM= whole milk; WM+MR= whole milk+milk replacer; WM+CS= whole milk+calf starter; MR+CS= milk replacer+calf starter; WM+MR+CS= whole milk+milk replacer+calf starter

Table 4: Fecal scores for calves fed on different experimental dietary regimes till weaning (Mean±SE)

	Treatments/groups				
	WM	WM+MR	WM+CS	MR+CS	WM+MR+CS
Experimental period (wk)					
1	2.0±0.07	2.11±0.22	2.0±0.05	2.05±0.25	2.0±0.06
4	2.11±0.32	2.17±0.38	2.05±0.23	2.02±0.16	2.05±0.23
8	2.0±0.1	2.08±0.21	2.0±0.08	2.0±0.09	2.0±0.08
12	2.0±0.09	2.05±0.12	2.14±0.15	2.0±0.11	2.05±0.15

WM= whole milk; WM+MR= whole milk+milk replacer; WM+CS= whole milk+calf starter; MR+CS= milk replacer+calf starter; WM+MR+CS= whole milk+milk replacer+calf starter

Table 5: Effects of calves fed different experimental dietary regimes till weaning on some blood parameters (Mean±SE)

	Treatments/groups				
	WM	WM+MR	WM+CS	MR+CS	WM+MR+CS
β-Hydroxybutyrate , mmol/L					
0 w	0.186±0.011	0.188±0.025	0.198±0.02	0.192±0.041	0.187±0.016
6 w	0.254^{b}±0.055	0.276^{b}±0.033	0.384^{a}±0.038	0.378^{a}±0.031	0.374^{a}±0.02
12 w	0.308^{b}±0.056	0.362^{b}±0.049	0.522^{a}±0.044	0.512^{a}±0.025	0.516^{a}±0.038
PUN, mmol/L					
0 w	2.42±0.094	2.44±0.13	2.38±0.076	2.42±0.076	2.38±0.1
6 w	2.60^{b}±0.093	2.74^{b}±0.12	2.96^{a}±0.186	2.96^{a}±0.18	2.95^{a}±0.1
12 w	2.77^{b}±0.085	3.02^{b}±0.13	3.49^{a}±0.188	3.45^{a}±0.17	3.48^{a}±0.11
Glucose, *mg/dL*					
0 w	85.0±2.23	85.8±1.3	86.0±2.55	86.8±2.28	86.0±2.12
6 w	81.6^{a}±1.95	80.2^{a}±0.48	70.2^{b}±1.92	70.8^{b}±1.48	72.6^{b}±1.52
12w	78.6^{a}±1.34	72.6^{a}±1.34	60.4^{b}±1.14	61.6^{b}±1.52	62.8^{b}±0.84

[a.b] Means in the same row with different superscripts are significantly different ($p < 0.05$)
WM= whole milk; WM+MR= whole milk+milk replacer; WM+CS= whole milk+calf starter; MR+CS= milk replacer+calf starter; WM+MR+CS= whole milk+milk replacer+calf starter

RESULTS AND DISCUSSION

Calf nutrition during pre-weaning period represents the greatest critical factor affecting the performance and health of the neonatal calves (Davis and Drackley, 1998).

Performance

Body weight development of the experimental calf-groups every 4 wk throughout the raising period are presented in Table (1). By the end of the 4th wk of age, raising feeding regime significantly affected the BW development. The calf-groups raised on MR with CS or WM followed by MR with CS had the highest BW (55.6 and 55.4 kg, respectively) compared with 51.2 kg for the calf-group fed WM along with CM. At weaning (12th wk of age), the calves received CS along with WM or MR or both attained higher body weights (91.6, 92.8 and 95.2 kg, respectively) than calves fed WM or MR with

CM (84.0 and 86.4 kg, respectively). Reviewing the data for BW development showed that offering CS along with WM or MR for the growing calf groups improved BW development than neonatal calves raised on WM or MR along with CM.

The present results showed that raising the newborn calves on WM for 2 wk followed by MR along with CS from the 5th d of age resulted in significantly higher BW gain (54.4 kg) compared with those fed WM or WM plus MR plus CM (Table 2). Generally, the average daily gain of the calves fed CS either with WM or MR or both was 0.61-0.64 kg/d, respectively compared well with expected growth rates in Holestein calves on enhanced early nutrition programs between 0.6-0.8 kg/d (Drackley, 2008). In all cases, availability of fresh, high quality starter feed from an early age is important for rumen development and preparation for weaning (Drackley, 1999).

It is clear from the results that BW gain achieved during the trial for calves fed WM or WM+MR had very lower values compared to other groups (Table 2). Although, it could be expected that higher rate of BW gain would be achieved by feeding of increased volumes of WM or MR than what is usually observed. This higher could be biologically normal growth, because it is closer to natural conditions in which calves would have ad lib access to milk. A calf kept with its dam will suckle on average seven to ten times a day, and consumes much more milk and gains weight at several times the rate of conventionally reared calves (Flower and Weary, 2001). Jasper and Weary (2002) reported average daily gain for the calves fed milk ad lib was 0.8 kg ± 0.1 in the first week after birth, compared to 0.2 kg ± 0.1 for the conventionally fed calves. Davis and Drackley (1998) reported that the growth of calves fed WM was 446 g/d compared to those fed milk replacer (289 g/day). Body stature measurements are used to monitor calf growth and estimate contemporary growth as part of the growth monitoring process (Wilson et al., 1997).

Body stature measurements

The length (mean) for calves is shown in Table (3). At 12th wk of age, the length of calves fed WM+MR+CS (group 5) had significantly higher body length value (118.8 cm) than those fed WM with CM or WM plus MR. In the same concept, Table (3) shows that calves fed WM+MR+CS had significantly higher body height value (89.6 cm) than those fed WM with CM or WM plus MR. At the end of experimental study (12th wk), no marked differences in heart girth were noted. Calves raised on WM or WM plus MR had significantly lower body depth value (36.4 and 37.2 cm, respectively) compared to other groups (Table 3).

The results show that the body stature (body length, shoulder height, heart girth, body depth) measures (± SEM) are increased along with age (Table 3). The increase in measured scales (representing the body size) mostly is parallel to increasing in BW (Table 1). The increase in stature measurements of the calves fed CS+WM+MR demonstrate that increases in BW were also increases in frame size and not just gain of gut fill or body fat.

The data indicate that the calves fed WM+CS or MR+CS have greater overall body statures than the calf-groups fed WM or MR. Brown et al. (2005) reported that calves fed MR (30% CP and 16% fat) with CS start gained higher body size than calves fed MR (21% CP) and CS (16.5% CP). Blome et al. (2003) concluded that there were no significant differences in wither height between calves fed MR containing 16.1, 18.5, 22.9 or 25.8% CP. Furthermore, Bartlett et al. (2006) reported that there was a significant increase in body length with an increase in CP content of the calves' diet.

Fecal score

Results of fecal score for the 12 wk raising trial are presented in Table (4). The data revealed that fecal score ranged from 2.0 to 2.14 for the calf-groups fed WM or MR with CS. On the other hand, the fecal score for the whole feeding trial ranged from 2.0 to 2.11 for the calf-group raised on WM or WM+MR with CM. The average fecal score was not significantly affected by the system of rearing. Throughout the experimental period the fecal score was around score 2. However, one could expect that in first group (WM plus CM), calves could have greater fecal score than other groups due to effect of WM intake, but it was not.

Blood β-hydroxybutyrate

Calves fed WM or WM plus MR with CM had significantly lower blood β-hydroxybutyrate levels (0.308 and 0.362 mmol/L, respectively) than other groups at 12th wk of age (Table 5).

The measurement of BHBA is indicative of rumen development. It is well known that CS diets containing higher amounts of fermentative carbohydrates tend to result in increased butyrate and propionate molar proportions at the expense of acetate (Schwartzkoft-Genswein et al., 2003). Increased BHBA production in serum is a sign that the bacterial flora is developing (Quigley et al., 1991). Due to the fact that young ruminants have little microbial fermentation occurring, smaller amounts of ketones are produced, leading to less BHBA. However, BHBA production in serum will increase as the amount of starter intake increases.

Plasma urea nitrogen

Table (5) shows that plasma urea nitrogen levels were significantly higher for newborn calves fed CS with MR or WM or both than other groups. The presence of urea in the blood demonstrates the utilization of crude protein that the animal is receiving. When higher protein diets are fed, this leads to an increase in both urea and nitrogen in the ruminant's urine. Likewise, when low protein rations are fed, there will be a decreased amount of urea in the urine and blood due to the reutilization of urea (Hayashi et al., 2006). This finding was in line with results of study on mature cattle that reported cows on a diet with a higher CP concentration having greater PUN values than cows on a diet with lower CP concentrations (Colmenero and Broderick, 2006).

Blood glucose

Neonatal calves fed WM or WM+MR with CM had significantly higher serum glucose values than other groups (Table 5) which could be due to calves rely more on glucose for energy metabolism rather than VFAs due to undeveloped rumen. Carbohydrates obtained from feedstuffs are fermented in the rumen and converted to VFA which include acetate, butyrate, and propionate. In a study by Owens et al.

(1986), it was reported that calves fed a diet of MR only did not have the gluconeogenic pathways required to release insulin while calves fed MR with grain had gluconeogenic pathway. This indicates that grain is essential not just for rumen development but also for the development of metabolic pathways.

The blood glucose levels were high in different calves' group at 6th wk of age compared to that at 12th wk of age (Table 5). Quigley et al. (1991) noted that glucose levels of calves after a meal and weaned at 25 days were greater than those calves weaned at 56 days. This was attributed to glucose being absorbed directly through the intestinal wall reaching and the blood at a faster rate than carbohydrates fermented to propionate and used in the gluconeogenic pathway.

In conclusion, it seems that raising neonatal calves on WM+MR+CS is the most suitable system regarding the body weight gain as well as body stature values followed by MR+CS system.

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الملخص العربي

تأثير تغذية العجول علي اللبن او بديل اللبن مع البادئ على معدلات النمو وبعض مكونات الدم

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فى جمهورية مصر العربية التى يتجاوز عددها المائة مليون نسمة يعتبر توفير مصدر كافي للبروتين الحيوانى ضرورة ملحة وتأتى اللحوم الحمراء على رأس قائمة مصادر البروتين الحيوانى. ومن أجل التوسع فى تربية الأبقار المنتجة للحم فأننا نحتاج لتربية المزيد من العجول الرضيعة والتى بدورها تستهلك كميات أكبر من الألبان التى نحتاجها لتوفير المتطلبات المتزايدة للأنسان. و لهذا أصبحنا بحاجه الى نظم تربية متطورة لهذه العجول من الميلاد وحتى الفطام لنضمن أعلى معدلات النمو وأقل احتمالات حدوث الأمراض الغذائية والمعدية مع توفير أكبر قدر ممكن من الألبان لحاجة الانسان.

لذا فقد اجريت هذه الدراسة لتقييم معدلات النمو ونمو الكرش والتخمر به والصحة العامة لخمسه مجموعات من العجول الرضيعه تم تغذيتها بطرق مختلفة من الميلاد وحتى الفطام اعتمادا على اللبن الكامل والبدائل الصناعية وبادئ تركيز ٢٠% بروتين لمعرفة أى الانظمة أفضل صحيا وأقتصاديا مع معرفة دور البادئ فى نمو و صحة هذه العجول.

أجريت الدراسة على عدد ٢٥ عجل هولشتين بداية من الميلاد تم تقسيمهم الى خمس مجموعات كل مجموعة مكونة من خمسة عجول على أن تحظى كل مجموعة بنظام تغذية مختلف عن الأخرى .

المجموعة الأولى : مؤلفة من خمسة عجول تم تغذيتهم علي لبن السرسوب لمدة ٣ أيام ثم تغذوا على اللبن طوال مدة التجربة مع مخلوط ذرة ونخالة حتى الفطام مرتين يوميا بواقع ١٠% من وزن العجل عند الميلاد تقسم على المرتين .

المجموعة الثانية : خمسة عجول تم تغذيتهم على السرسوب لمدة ٣ أيام ثم لبن مرتين يوميا لمدة ١٥ يوم فقط ثم بديل اللبن مع مخلوط ذرة ونخالة حتى الفطام والتغذية مرتين يوميا على ١٠% من وزن الميلاد مقسمة على المرتين.

المجموعة الثالثة : غذيت العجول علي على اللبن ولكن تم وضع بادئ ٢٠% بروتين أمام العجل يتغذى منه حسب حاجته بداية من عمر خمسة أيام. المجموعة الرابعة: تم تغذيتهم على بديل اللبن مع البادئ .المجموعه الخامسة: استقبلت السرسوب ثم اللبن حتى عمر ١٥ يوم ثم بديل اللبن حتى النهاية مع توافر بادئ أمامه حسب احتياجه .

تم استخدام نفس بديل اللبن ونفس البادئ طوال مدة الدراسة وبالنسبة لجميع العجول تم تقييم الأوزان وأبعاد الجسم لها اسبوعيا وتدوينها كل ١٤ يوم وتدوين كمية البادئ ومخلوط العلف المستهلكة لكل عجل بالجرام وكذلك حساب معدلات الاسهال يوميا. بالأضافة لأخذ عينات دم من كل العجول عند عمر صفر و٦ و١٢ أسبوع لقياس نسبة الجلوكوز فى الدم ونسبة اليوريا وبيتا هيدروكسيبيوتيريت وهذه القياسات تعطى مؤشرات عن نمو العجول وتطور جهازها الهضمى والكرش لتتحول من عجول رضيعة الى فطيمه وتبدأ الاعتماد على طعام المجترات .

وأدت التجربة إلى النتائج التالية :

تغذية العجول علي بادئ مع اللبن (حتي ١٥ يوم) وبديل اللبن ادي الي زيادة معنوية في وزن العجول بالمقارنة بالعحول التي تتم غذي فقط علي اللبن او اللبن مع بديل اللبن. وبالتالي عند تقييم ابعاد وحجم جسم العجول فكانت المجموعات التي تتغذي علي بادئ مع اللبن (حتي ١٥ يوم) وبديل اللبن ذات فروق معنوية كبيرة بالمقارنة بالعحول التي تتغذي فقط علي اللبن او اللبن مع بديل اللبن.مع الاخذ في الاعتبار ان العجول الاخري والتي تغذت علي بادئ مع اللبن او مع بديل اللبن لا يوجد بينها فروق معنوية بالنسبة لمقدار الزيادة في الجسم او لقياسات ابعاد الجسم. كما ان تغذية العجول علي بادئ مع اللبن (حتي ١٥ يوم) وبديل اللبن ادت الي تطور ونمو الكرش بدرجة كبيرة ومعنوية عن العجول التي تتغذي فقط علي اللبن او اللبن مع بديل اللبن.