

STUDIES ON PERFORMANCE OF BUFFALO CALVES FED ON ACIDIFIED MILK

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SUMMARY

Fifteen water buffalo calves 15 days old were divided depending on weight and sex into three groups with mean birth weight of 35.4 kg. The effects of three buffalo milk diets: untreated milk (G1) or cold milk acidified with formic acid (3ml/liter, G2) or citric acid (1 g/liter, G3) were studied.

The experiment lasted for 114 days as a mean, the weaning weight ranged from 82 to 93 kg. Animal weights were recorded every two weeks. Feed intake was measured daily, cases of diarrhea and any other diseases were recorded. The experiment was divided into two stages; liquid feeding period (first 45 days) and liquid plus solid feeding period (from 46 days to weaning).

In the first period, calves were fed for 45 days only on buffalo milk to study their performance without interaction of solid feeds. Three liters of buffalo milk were given in two daily portions (2 liters in the morning and one liter afternoon). Digestibility trial and blood serum sampling were conducted at 45th day. In this period; feed efficiency on the base of DM intake (kg) / kg gain were 1.2, 1.4 and 2.06 for control, formic and citric groups, respectively. However in the 1st month control group was superior to formic and citric groups in average daily gain (ADG), control gained 433 g/day in comparison with 333 and 253 g/day for formic and citric groups, respectively. In the second month formic group reached 379 g/day in comparison with 306 and 299 g/day for control and citric groups, respectively. Dry matter intake was nearly similar for all groups, on the other hand treated groups were superior to control in nutrients digestibility ($p < 0.05$ or 0.01), but there weren't any significant differences between groups in blood serum parameters.

In the second period, calves were fed on starter beside milk till weaning. Digestibility trial and blood serum sampling were conducted at 90th day. There weren't significant differences between groups in calves weight, average daily gain, milk intake, starter intake or TDN intake. Mean values recorded for feed efficiency on the base of DM intake (kg)/kg gains were 2.18, 2.52 and 3.13 for control, formic and citric groups, respectively. Formic group gained 559 g/day compared with 466 and 406 g/day for control and citric groups, respectively. Treated groups were significantly higher than control group in nutrients digestibility. Blood serum parameters were within the normal range without significant differences between groups, there weren't any harmful effects due to experimental treatments. Diarrhea and pneumonia infections were significantly different among groups, calves given cold milk acidified with formic acid recorded the lowest diarrhea infections.

Key words: *Acidified milk, buffalo calves, nutrients digestibility, blood serum and calf performance.*

INTRODUCTION

Newly born buffalo calves on artificial rearing systems are usually sustainable to gastric intestinal disturbance and diarrhea. Microbes in gut such as *E. Coli* and *Salmonella* usually cause gastric intestinal disorders. The infection with gut microbes is accompanied usually with diarrhea, which is related sometimes with secondary infection; pneumonia. Infecting with gut microbes is related with poor performance and great losses. The challenge for research and feed manufactures is to select economical compounds, which can be used to decrease infection and disorders.

Regulation in the European Union now restricts the use of most pharmaceutical-type antibiotics at subtherapeutic levels in feed. Acid-type additives are especially useful for suckling animals. Acids are effective against disease-causing microbes in the gut (Puyalto and Mesia 2002).

Neonatal calf diarrhea is currently an important cause of death and considered to be one of the main hazards to calf health (Abd El Aziz 1998). In Egypt, enteritis and diarrhea appear to be the most serious disease among newly born calves (Fadl Allah, 1996). The disease affects calves few hours after birth to few weeks of age (Roy, 1990). The studies on neonatal buffalo calves revealed a remarkable increase of the incidence of diarrhea reaching a percentage of 67 with a mortality rate of 10.78% (El-Garhi *et al.*, 1994).

Short chain organic acids such as formic, propionic and butyric acids are the most effective bactericides. They have the capacity to penetrate the cell in a non-dissociated form and be dissociated in the inside, causing osmotic dysfunction and altering the metabolism of the

bacteria, which results in irreversible damage.

The feeding method used in this study was differed from the feeding methods used in the past in some points: Using restricted amount of acidified buffalo's milk. Krasa *et. al.* (1987) and Skrivanova *et. al.* (1990) used acidified cow's milk in their experiments. Using a high quality starter. Also Tim (2000) and Vajda (1998) fed calves on acidified milk with a high quality starter. Using cold milk (at the room temperature) in a lower quantity than usual. El- Ashry *et. al.*, (1988 a & b) used warm milk (37-40°C) in a higher quantity than used in this experiment.

During the rearing period, the calf should be changed as early as possible from a monogastric to a ruminant animal with fully functional fore-stomachs, firstly because the danger of digestive upsets and loss, and secondly because feeds for ruminants are cheaper. During the rearing period calves should grow steadily without putting on too much fat.

Some studies were done to identify the effect of feeding acidified liquid milk on calf performance (Skrivanova *et.al.*, 1990; Otterby and Linn 1992; Vajda, 1998 and Tim, 2000).

This experiment was designed to examine the different variations of this method. The parameters, which particularly interested us, were calves' health, feed consumption, weight gain and feed costs.

MATERIAL AND METHODS

The objective of this investigation was to study the effect of feeding acidified milk on the performance of buffalo calves. Two different organic acids (citric and formic) were added to milk with rate of 1 g citric acid/ 1 liter (Muller *et al.* 1985) and 3 ml. formic acid/ 1 liter (Nohner and Hahn 1988).

A total of 15 newly born buffalo calves [9 males and 6 females] of 35.4 kg birth weight were used in this study. The animals were weaned from their dams after natural rearing for two weeks. Animals were distributed according to their body weights, and sex to 3 groups, each group consists of 5 calves (3 males and 2 females). Rectal temperature of each calf was recorded twice weekly before feeding time. Weight of the animals were taken every two weeks from birth to weaning. The mean values of weaning weight were 86.8, 88.4 and 83.4 kg for control, formic and citric groups, respectively. The age of the experimental animals at weaning were 117, 111 and 114 days for control, formic and citric groups, respectively.

The experiment was divided into two periods: the liquid feeding period (from 15 to 45 days) and liquid plus solid feeding (starter) period, which continued till weaning. The liquid diet was whole buffalo's milk; all calves in all groups were offered 3 liters of milk daily. Starter was fed to calves in all groups after 45 days age (400-g daily) and increased gradually according to calf needs, with weighing the residues daily to calculate the intake.

Every calf in each group received 3 liters of milk daily (2 liters at 7.00 a.m. and 1 liter at 2.00 p.m.). Two weeks before the end of the experiment, each calf received 2-liters/ day then 1 liter/ day in the last week, then the calf was weaned. Control calves received their milk at 37-40°C, as it was packet in a teat nipple (1-liter) and fed to the calf. For experimental groups formic (G2) or citric acids (G3) were added to milk and left in a shade building at room temperature (between 19-22° C), then, it was packet in a teat nipple (1 liter). Formic and citric acids were mixed well with the milk

before feeding. Fresh water was offered freely all the day.

Vitality of young calves was judged according to the incidence of diarrhea and visual examination of different regions of the body (e.g. hair, muzzle and rectal temperature). When diarrhea was occurred it was immediately treated with antibiotic (2 Tablets of antocide reg./day for 3 days), pneumonia was treated with ampicillin injection (1 g/day for 3 days).

Two digestibility trials were conducted using every calf (male and female) in the experimental groups. The first digestibility trial was carried out at the end of liquid feeding period during the 6th week of age. The second digestibility trial was conducted during the 12th week of age. Fecal grape samples were taken from calf at three successive days. It was weighed fresh and 10 ml of 10% sulfuric acid and 10 ml of formalin were added to it for preservation then dried in an oven at 60°C, for 24 hours. At the end of collection period, feces samples for each calf were finely grounded, mixed well and kept in plastic bottles until analysis.

Blood samples were taken from all experimental calves at 45th and 90th day of age, at three hours after morning feeding. A sample of 15 ml of blood per animal was withdrawn from the jugular vein. The blood was directly collected into a clean dried glass culture tubes, it was left at room temperature (35-37°C) for 45-60 minutes, then, centrifuged at 4000 r.p.m for 15 minutes. Blood serum was separated into clean dried glass vials and stored at -20°C until analysis.

Proximate chemical analysis of starter and feces samples in triplicates per each determination were analyzed for dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF), and ash content according to the A.O.A.C. methods (1995). The nitrogen free extract

(NFE) was calculated. Chemical composition of different feed sources used in the experiment (DM basis, g./kg.) is presented in Table (1).

Blood serum samples were analyzed for the following parameters: total proteins (Henry 1964), Albumin (Doumas 1971), Serum urea (Patton and Crouch 1977), Calcium (Saunders 1970), In-organic phosphorus (Armstrong and Carr 1964). Globulin was calculated by subtraction of serum albumin from total serum proteins and Albumin/ Globulin ratio (A/G ratio) was calculated. The data were analyzed according to statistical analysis system, (SAS) User's Guide, (1998). Separation among means was carried out by using Duncan multiple test, (1955).

RESULTS AND DISCUSSION

Effect of treatments on feed intakes:

Data concerning feed intakes in different stages are presented in Table (2).

1-First Period: Milk intake was almost similar for all groups, as every calf in each group was offered 3 liters of milk daily. Group 2 consumed less milk because some of G2 calves refused to drink acidified milk at the beginning of the experiment. Generally dry matter, protein and TDN intakes were almost similar for all groups, except a slight decrease of TDN intake in G2.

2- Second Period: The highest mean DM intake from milk was experienced for control group, which exceeded the milk consumption of G2 by 9%, the differences in milk intake weren't significant ($P > 0.05$). There were no significant differences concerning dry matter intake. The highest intake from starter was observed for formic acid treated group being 150.3 and 108.2% of those of control and citric acid group, respectively. Also it is of interest to note

that, citric acid treated group consumed 138.8% of that of the control. This may indicate that, acidification may enhance rumen growth and development which can be reflected on more solid feed intake. The dry matter intake from milk was 43.2, 33.1 and 34.6% of the total dry matter intake for G1, G2 and G3 respectively. The TDNI of milk during this experimental period as percentage of total intake was 57.1, 47.4 and 47.9% for G1, G2 and G3 respectively. These results are similar to the values recorded by Krasa *et al.* (1987) and Skrivanova *et al.* (1990).

Effect of Treatments on Body Weight changes and Growth Rate:

Data concerning means of birth weight, monthly body weights, weaning weights and growth rates of the different groups in the different periods are presented in Table (3).

1-First Period: The mean values recorded for birth weight were 35 kg for G1 and 35.6 for G2 and G3 (Table 3). There were no significant differences among groups in birth weight or monthly body weights. Although G1 scored the lowest record for birth weight but it showed the highest weight at the end of the 1st month (44 kg) followed by G2 (43.6 kg) and G3 (42.2 kg). On the other hand, G2 showed the highest 2nd month body weight (55 kg) compared with 53.2 and 51.2 kg for G1 and G3 respectively. The results showed that the highest daily gain in the 1st month was recorded for G1 (433 g /day) followed by G2 (333 g /day) and G3 (253 g /day). There were no significant differences among groups in growth rate ($P > 0.05$).

2- Second Period: The mean values recorded for 3rd month weight were 71.8, 66.6 and 65.4 kg for G2, G1 and G3 respectively. Group (2) recorded the highest weaning weight (88.4 kg).

Table (1) : Chemical composition of buffalo's milk and starter (% on DM basis)

Item	DM	Proximate analysis (% as DM basis)				
		CP	CF	EE	NFE	Ash
Buffalo milk*	17.76	26.58	00.00	42.29	26.85	04.28
Starter**	89.30	14.20	12.60	06.50	54.20	12.50

* Gad, Nadia A. (1984)

** Starter was composed of: 45% corn, 16% wheat bran, 25% sunflower meal, 5% rice bran 5% molasses, 1% NaCl and 3% vitamins and mineral additives. The calculated TDN content of the starter was 69.33%

Table (2) : Mean values for the different treatments of total feed intakes (kg) in he different experimental periods.

Item	First period (first 45 days)				Second period (46 th day to weaning)			
	G1	G2	G3	SE	G1	G2	G3	SE
Milk intake:								
Whole Milk	88.0	80.0	88.0	3.01	179.0	175	173.0	0.75
DM	15.6	14.2	15.6		31.8	31.1	30.7	
CP	04.1	03.8	04.1		08.4	08.2	08.1	
TDN	21.2	20.1	21.2	0.76	43.2	44.0	41.4	0.97
Starter intake:								
Starter	-	-	-		46.7	70.2	64.9	3.38
DM	-	-	-		41.7	62.7	57.9	
CP	-	-	-		06.6	09.9	9.2	
TDN	-	-	-		32.4	48.7	45.0	6.84
Total Intake:								
DM	15.6	14.2	15.6	0.52	73.5	93.8	88.6	2.80
CP	04.1	03.8	04.1		15.1	18.2	17.4	
TDN	21.2	20.1	21.2	1.73	75.6	92.7	86.4	6.11

-CP of milk= 4.72%, CP of starter= 14.2%, total solids in milk =17.76, DM of starter= 89.3%.

-Calculated TDN of starter= 69.33%, TDN of milk= 24.16, 25.14 and 23.96% for G1, G2 and G3 respectively.

Table (3) : Mean values for different treatments of body weight (kg) and growth rate (g/ day)

Item	Groups			SE
	G1	G2	G3	
Birth weight	35.0	35.6	35.6	3.09
Initial experimental weight	37.5	38.6	38.4	
1 st month weight	44.0	43.6	42.2	
2 nd month weight	53.2	55.0	51.2	
3 rd month weight	66.6	71.8	65.4	
Weaning weight	86.8	88.4	83.4	2.53
Weaning age (days)	117	111	114	7.56
1 st month ADG*	433	333	253	0.04
2 nd month ADG	306	379	299	0.06
3 rd month ADG	466	559	406	0.09
90 th day till weaning ADG	725	780	626	0.11

* ADG= average daily gains (g/ day)

followed by G1 and G3 with corresponding values of 86.8 and 83.4 kg, respectively. These results showed that, adding formic acid to the milk might improve starter intake because milk intake and birth weight were almost similar for all groups. It was shown that there were no significant differences among groups in body weight or weaning weight. The highest mean daily gain during the 3rd month of the experiment was that of G2 which received formic acid acidified milk and ADG was higher than G1 and G3 by 12.7 and 37.7%, respectively. During the end period of the experiment the mean daily gain of G2 continued to surpass the corresponding values of G1 and G3 by 7.6 and 24.6% respectively. Because the milk intake was almost similar for the different treatment groups formic acid might be improved rumen activity. Generally the performance of calf group received formic acid treated milk was the best followed by calf group on untreated milk that might be due to the normal flavor of untreated milk, which was better accepted by calves. There were no significant differences among groups in daily weight gains. El- Ashry *et al.*, (1988 a) fed buffalo calves on different milk replacers reported 413 to 540 g average daily gain for different groups during the liquid plus solid feeding period, but the differences weren't significant.

Effect of Treatments on Nutrients Digestibility: Data concerning nutrients digestibility are presented in Table (4).

1-First Period: Group 2 showed the highest digestibility of DM ($P<0.01$), CP ($P<0.01$), EE ($P<0.05$) and insignificantly higher NFE (Table 4). G3 recorded the lowest value in CP digestibility and intermediate in DM digestibility. On the other hand, G1 was the lowest ($P<0.01$) in DM digestibility

and intermediate in the other parameters. There were significant differences among groups in crude protein digestibility ($p<0.05$). These results are supported by El- Ashry *et al.*, (1988a) who reported that the values of apparent digestibility of DM differed significantly between groups and ranged from 87 to 91%, crude protein digestibility ranged from 91 to 95%, EE digestibility ranged from 89 to 92% and NFE digestibility ranged from 83 to 92% for the different groups fed milk replacers.

2- Second Period: The data in Table (4) showed that G2 scored the highest digestibility of DM ($P<0.01$), CP ($P<0.01$), CF ($P<0.01$), EE and NFE ($p<0.05$). These data are similar to those obtained by Guilloteau *et al.*, (1981), Campos and Haber (1983), Petit *et al.*, (1989) and Higginbotham and Bath (1993). They reported that, rearing cow calves on milk or milk replacers acidified with formic acid increased digestibility of DM, CP and CF significantly. On the other hand G3 recorded the lowest values of CP ($P<0.01$), CF and NFE digestibility and intermediate in DM, CF and NFE digestibility. While G1 was the lowest in DM ($P<0.01$) and EE digestibility and intermediate in CP, CF and NFE digestibility. These results are supported by the results obtained from Wilson *et al.* (1995) and Vajda (1998) on cow calves fed on acidified or untreated milk replacer.

Feed Conversion: Data concerning feed conversion per kg daily gains are presented in Table (5).

1-First Period: It should be noted that, group 1 showed lower intake from DM, CP and TDN/ kg gain. However differences between groups in FC didn't attain significance in terms of DMI or TDNI (Table, 5). However G3 showed significantly higher values of protein

intake/ kg gain than other groups ($p < 0.05$). These values are lower than the values recorded by El-Ashry *et al.* (1988b) who reported DMI/kg gain between 3.4 to 14.5 kg, while TDNI/ kg gain ranged between 3.8 to 16.6 kg for buffalo calves fed on milk replacer. The results showed that G1 and G2 converted their diets into live weight gain more efficiently than G3, (Table 5).

2- Second Period: The results showed that, G1 calves converted their diets into live weight gain more efficiently than other groups, followed by G2 then G3. Statistical analysis of the data showed that there were significant differences among groups in feed conversion on the base of DMI. However differences among groups in feed conversion on the base of CPI or TDNI were not significant (Table 5). On the other hand, Woodford *et al.* (1987) and Erickson *et al.* (1989) reported that, feed conversion were similar across diets (acidified with formic or citric and untreated).

Blood Serum Parameters: Data concerning blood serum parameters in 45th and 90th day of age are presented in Table (6).

1-First Period: The highest albumin and calcium concentrations were recorded for G2, which showed the lowest concentrations of total proteins, globulin, urea and inorganic phosphorus. However, G3 recorded the highest concentrations of globulin, urea and inorganic phosphorus which agree with Fadl Allah (1996), but it scored the lowest albumin concentration and it was intermediate in total proteins and calcium concentration. G1 recorded the highest total proteins concentration, the lowest calcium concentration and the intermediate values in the other serum blood parameters (Table 6).

2- Second Period: The results showed that, the highest total proteins, albumin and inorganic phosphorus concentrations were recorded for G1, followed by G2 then G3. These results are supported by Abd El-Aziz (1998) who found that, there were a rise of total proteins and albumin for the group with the highest diarrhea infection. The highest globulin and calcium concentration were recorded for G2 followed by G1 then G3 which recorded the highest concentration of urea followed by G1 then G2. These results are in agreement with El-Ashry *et al.* (1988a) and Lanuza *et al.* (1990).

General Health for the Experimental Animals: Data concerning the incidence of diarrhea and pneumonia in the different experimental periods are presented in Table (7).

Diarrhea occurred more frequently in G3 (42 cases) followed by G1 (28 cases) particularly during the first period. Although G2 scored the lowest rate of infection (7 cases), ($P < 0.05$) but it scored the highest rate of pneumonia infection (5 cases) followed by G3 (2 cases), there was no pneumonia infection in G1. The cases of diarrhea or pneumonia weren't very severe. There was a change in feed intake during the period of disease. The data showed that frequency of diarrhea was higher during the 1st month of and this was associated with a decrease of albumin: globulin ratio in the 1st period of G1 and G3. While 2 cases of pneumonia and 7 cases of diarrhea couldn't affect the albumin: globulin ratio in the second period of G3.

From the present study, the two most important prerequisites for the success of acid feeding techniques are: the correct choice of milk or milk replacer and the selection of a suitable preservative. As formic then citric acid are the most widely used preservatives for this

Table (4) : Effect of treatments on nutrients digestibility in 6th and 12th week of age.

Item	Digestion trial							
	6 th week				12 th week			
	G1	G2	G3	SE	G1	G2	G3	SE
DM%	88.8 ^b	92.5 ^a	91.9 ^a	0.30	84.4 ^z	90.5 ^d	87.0 ^d	0.43
CP%	90.5 ^b	95.4 ^a	88.7 ^c	0.54	87.0 ^c	91.0 ^d	84.6 ^f	0.69
CF%	-	-	-	-	62.1 ^c	76.4 ^d	61.1 ^c	1.13
EE%	92.1 ^b	96.3 ^a	91.6 ^b	0.44	91.1	92.5	91.8	1.22
NFE%	90.8	91.7	90.2	0.38	88.5 ^c	92.4 ^d	88.2 ^c	0.53

a, b and c: means in the same raw with different superscripts are significant ($p < 0.05$) in the 6th week.

d, e and f: means in the same raw with different superscripts are significant ($p < 0.05$) in the 12th week.

Table (5): Effect of treatments on feed conversion (kg intake/kg gain).

Item	First period			Second period		
	G1	G2	G3	G1	G2	G3
DMI	1.20	1.40	2.06	2.18	2.52	3.13
CPI	0.32 ^b	0.37 ^b	0.54 ^a	0.61	0.49	0.54
TDNI	1.63	2.01	2.80	2.16	2.49	3.06

a and b: means in the same raw with different superscripts are significant ($p < 0.05$)

Table (6) : Effect of treatments on some blood serum parameters in 45th and 90th day of age.

Item	Sampling trials							
	First period				Second period			
	G1	G2	G3	SE	G1	G2	G3	SE
Total proteins (g/dl)	6.80	6.30	6.75	0.42	7.26	7.10	6.69	0.40
Albumin (g/ dl)	3.40	3.50	3.08	0.23	3.86	3.62	3.29	0.38
Globulin (g/ dl)	3.44	2.80	3.67	0.40	3.40	3.49	3.40	0.40
A/ G ratio	0.98	1.20	0.84	-	1.13	1.03	0.96	-
Urea (mg/ dl)	30.0	28.4	30.2	2.44	40.1	35.	46.3	3.34
Calcium (mg/ dl)	11.4	12.0	11.7	0.85	12.1	12.1	9.88	0.98
Inorganic Phosphorus (mg/ dl)	5.82	5.59	6.07	0.20	5.93	5.76	5.50	0.30

Table (7) : Effect of treatments on animals health

Age	Diarrhea				Pneumonia		
	G1	G2	G3	G1	G2	G3	
15-30	18 ^a	1 ^b	20 ^a	0	3	0	
30-45	10 ^a	0 ^b	15 ^a	0	2	0	
45-60	0	6	7	0	0	2	
60-75	0	0	0	0	0	0	
75-90.	0	0	0	0	0	0	

a and b: means in the same raw with different superscripts are significant ($p < 0.05$)

purpose, for its properties and characteristics:

1-Formic and citric acids occur in nature and can be prepared in the laboratory.

2-They are simple, strong organic acids and possesses both bactericidal and fungicidal properties especially formic acid.

Conclusion

It is recommended that, formic acid could be successfully used in acidifying buffalo milk with a little effect on buffalo calves performance. The results showed that using citric acid in acidifying buffalo milk is less effective as citric acid group recorded the lowest average daily gain and the lowest weaning weight.

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دراسات على أداء العجول الجاموس المنشأة على لبن محمص

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تم توزيع ١٥ عجل جاموسي في اليوم الخامس عشر من العمر حسب وزنها و جنسها إلى ٣ مجموعات متوسط أوزانهم عند الولادة ٣٥,٤ كجم بهدف دراسة الأداء الإنتاجي لعجول و عجلات الجاموس المغذاة على لبن جاموسي محمص و قد شملت الدراسة تأثير إضافة مصدرين مختلفين من الأحماض العضوية المنتجة محليا (الفورميك [٣ مل/لتر] أو الستريك [١ جم/لتر]) على الأداء الإنتاجي لعجول و عجلات الجاموس حديثة الولادة. استمرت التجربة بمتوسط ١١ يوم حيث كان يتم الفطام عند وزن ٨٢-٩٢ كجم ثم تسجيل الوزن كل أسبوعين و مقدار المأكول يوميا مع ملاحظة الصحة العامة و تسجيل اي حالة إسهال أو أي أمراض أخرى و قد كانت التغذية تتم على مرحلتين:

أولا : مرحلة التغذية السائلة:

و فيها غذيت العجول لمدة ٤٥ يوم على اللبن الجاموسي فقط لدراسة تأثير التغذية السائلة على الأداء الإنتاجي للعجول بدون تداخل للأغذية الصلبة و كان معدل التغذية ٣ لتر لكل يوم (٢ لتر صباحا و ١ لتر مساء) كما أجريت تجربة هضم و أخرى لدراسة مقاييس الدم عند عمر ٤٥ يوم. بلغت الكفاءة التحويلية في نهاية هذه المرحلة على أساس كجم مادة جافة مأكولة لكل كجم نمو ١,٢ و ١,٤ و ٢,٠٦ لكل من مجموعة المقارنة و الفورميك و الستريك على التوالي. أما معدل النمو اليومي في الشهر الأول فقد تفوقت فيه مجموعة المقارنة على مجموعتي المعاملة (٤٣٣ جم/ يوم) مقابل ٣٣٣ و ٢٥٣ جم/ يوم لكل من مجموعتي الفورميك و الستريك على التوالي. أما في الشهر الثاني تفوقت مجموعة الفورميك حيث سجلت ٣٧٩ جم/ يوم مقابل ٣٠٦ و ٢٩٩ جم/ يوم لكل من مجموعتي المقارنة و الستريك على التوالي. و كانت كمية المادة الجافة المستهلكة متقاربة في المجموع الثلاثة. و تفوقت مجموعتا المعاملة على مجموعة المقارنة معنويا (مستوي معنوية ٠,٠٥ أو ٠,٠١) في معاملات الهضم. و لم تسجل أي فروق معنوية في أي من مقاييس الدم بين المجموعات.

ثانيا : مرحلة التغذية الصلبة:

و فيها غذيت العجول على البادئ بجانب التغذية السائلة من نهاية المرحلة السابقة حتى الفطام، كما أجريت تجربة هضم أخرى لدراسة مقاييس الدم عند ٩٠ يوم من عمر الحيوان. لم يكن هناك فروق معنوية بين المجموعات في وزن الحيوانات أو معدل نموها، كذلك لم يكن هناك اختلاف معنوي بين مجموعة المقارنة و مجموعتا المعاملة في كمية اللبن أو البادئ أو مجموع المركبات الغذائية المهضومة أو معامل التحويل الغذائي على أساس كمية المادة الجافة المستهلكة. بلغت الكفاءة التحويلية على أساس كجم مادة جافة مأكولة لكل كجم نمو ٢,١٨ و ٢,٥٢ و ٣,١٣ لكل من مجموعة المقارنة و الفورميك و الستريك على التوالي. أما معدل النمو اليومي فقد تفوقت فيه مجموعة الفورميك (٥٥٩ جم/ يوم) مقابل ٤٦٦ و ٤٠٦ جم/ يوم عند عمر ٩٠ يوم لكل من مجموعتي المقارنة و الستريك على التوالي. و سجلت مجموعتا المعاملة زيادة معنوية (مستوي معنوية ٠,٠٥) في كمية المادة الجافة المستهلكة. و تفوقت مجموعتا المعاملة على مجموعة المقارنة معنويا (مستوي معنوية ٠,٠٥ أو ٠,٠١) في معاملات الهضم. و لم تسجل أي فروق معنوية في أي من مقاييس الدم بين المجموعات. و عموما كانت قيم قياسات الدم في المتوسط الطبيعي مما يدل على عدم ظهور أي آثار ضارة من استخدام المعاملات المختبرة.

لوحظ أن هناك فروق معنوية بين المجموعات في عدد حالات الإصابة بالإسهال أو الالتهاب الرئوي حيث لوحظ أن المجموعة المغذاة على لبن جاموسي محمص بحمض الفورميك سجلت أقل نسبة إصابة بالإسهال. عموما كان هناك تأثير إيجابي على دراسة الأداء الإنتاجي للعجول الجاموس المغذاة على لبن جاموسي محمص بحمض الفورميك و العجول الجاموس المغذاة على لبن جاموسي غير معامل. لكن النتائج المتحصّل عليها من استعمال حمض الستريك لتحريض اللبن لم تكن مشجعة حيث أدى استخدامه لنقص معدل النمو و وزن الفطام.