EFFECT OF DIETARY PHOSPHORUS SUPPLEMENTATION ON PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF LACTATING FRIESIAN COWS

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ABSTRACT

Thirty Friesian cows were used after calving immediately to study the effect of dietary phosphorus levels on their productive and reproductive performances. Cows in the first group (control) were fed on a basal ration (R1) consisted of 40 % concentrate mixture (CM), 40 % berseem (B) and 20 % rice straw (RS), which provide calcium (Ca) and phosphorus (P) contents of 0.80 and 0.36 % on DM basis, respectively. For the other two groups (R2 and R3), cows were fed the basal ration with 50 and 100 g monosodium phosphate supplementation to provide 12.5 and 25.0 g P per cow daily and dietary P contents of 0.43 and 0.51% on DM basis, respectively.

Cows fed R2 (contained 0.43% P) had the highest nutrients digestion coefficients, nutritive values and also the intake of DM, TDN and DCP. The concentration of ruminal TVFA's increased, but pH value and NH_3-N concentration significantly decreased ($P<0.05$) with increasing dietary phosphorus level.

The concentrations of total protein, albumin, globulin and total lipids and the activity of AST and ALT in blood plasma of the lactating cows significantly increased ($P<0.05$) with increasing dietary phosphorus level and fall within the normal levels of healthy lactating cattle.

Cows fed R2 (contained 0.43% P) recorded the highest milk yield, 4% fat corrected milk, fat, protein, lactose, total solids and solids not fat in milk ($P<0.05$). The contents of fat, protein, lactose, total solids, solid not fat and ash in milk increased significantly ($P<0.05$) with increasing dietary phosphorus level.

Cows fed R2 (contained 0.43% P) had the highest feed and economic efficiency (P<0.05).

Phosphorus supplementation improved reproductive performance of cows fed R2, which recorded the short periods from calving to the first estrus and time first insemination, and days open and the lower number of insemination per service and the highest conception rate entire the first 90 and 120 days of lactation. Cows fed R3 (contained 0.51% P) recorded the short period from calving to the second insemination and the highest conception rate at the second artificial insemination and entire the first 150 days of lactation.

Key words: Phosphorus supplementation, lactating Friesian cows, productive and reproductive performance.

INTRODUCTION

Minerals are essential for the proper functioning of the animal and a problem arises when the feed does not supply enough to meet the animal's requirements. This may occur because the feed is low in minerals, the availability of the mineral is low, or another nutrient is interfering with the ability of the animal to absorb or utilize the mineral. A time factor is usually involved, it may take from weeks to several months of a mineral deficient diet before any negative effects occur. The animal may have sufficient body stores of the mineral to withstand a short period on a mineral deficient diet. Also, the efficiency of extraction or utilization of the deficient mineral may improve when the mineral is in short supply in the food (Malmberg *et al.*, 2003).

The following data are required if recommendations concerning phosphorus supply to farm animals are to be derived by use of the factorial approach: a) the respective concentrations of P in the different products such as conceptus, gain in body mass and milk. b) the inevitable losses of P from the body and c) the availability of dietary P, which is the maximum possible proportion of dietary P that can balance out the drain from the body caused by a and b (Muschen *et al.*, 1988).

Phosphorus is the second most abundant mineral element found in the animal body. Phosphorus is present in all common

feedstuffs, seeds are uniformly higher in P than in roughages. Seed by-products, such as wheat bran and oil meals are especially rich in P. Phosphorus is probably the most expensive mineral added in animal diets in relation to quantity required, whereas Ca is relatively cheap. Because of this price relationship, there is a tendency to feed excess Ca and to feed P to meet needs of the animals. However, results in the literature continue to support the need for maintaining a proper Ca: P ratio. Higher levels of both cane be tolerated by most species if the proper Ca: P ratio is maintained (McDowell, 1992). For grazing livestock, the most prevalent mineral element deficiency throughout the world is lake of P. Sings of P deficiencies are weight loss, reduced milk production, failure reproductive, limiting rumen microbial activity and reduces microbial protein syntheses (Ternouth, 1991).

The objective of this work was to investigate the effect of dietary phosphorus supplementation on productive and reproductive performance of lactating Friesian cows fed rations containing berseem in winter season.

MATERIALS AND METHODS

The current work was carried out during the period from the beginning of January to the end of May, 2003 at Sakha Animal Production Research Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture. Thirty Friesian cows with average body weight of 500 $\pm$ 0.17 kg were assigned randomly immediately after calving to three similar groups (10 in each) according to body weight, season of lactation and the production of the previous lactation. Cows in the first group (control) were fed on a basal ration (R1), which consisted of 40 % concentrate mixture (CM), 40 % berseem (B) and 20 % rice straw (RS), which provide calcium (Ca) and phosphorus (P) contents of 0.80 and 0.36 % on DM basis, respectively. For the other two groups (R2 and R3), cows were fed the basal ration along with 50 and 100 g monosodium phosphate (contained 25 % P) supplementation to provide 12.5 and 25.0 g P per cow daily (0.07 and 0.15% of DM) and dietary P contents of 0.43 and 0.51% on DM basis, respectively.

Chemical composition of tested feedstuffs and basal ration are presented in Table (1). Concentrate mixture consisted of 32% undecorticated cottonseed cake, 20% wheat bran, 25% yellow corn, 12% rice bran, 5% linseed cake, 5% molasses, 2% limestone and 1% common salt.

Table 1: Chemical composition of the tested feedstuffs and basal ration.

Items	DM	Composition of DM %							
	%	OM	CP	CF	EE	NFE	Ash	Ca	P
Concentrate mixture	90.75	91.40	16.35	13.15	3.42	58.48	8.60	0.55	0.60
Berseem	16.45	86.20	16.70	24.90	2.80	41.80	13.80	1.35	0.25
Rice straw	89.30	84.85	2.25	31.80	1.74	49.06	15.15	0.20	0.10
Basal ration (R1)	32.30	88.01	13.67	21.58	2.81	49.92	11.99	0.80	0.36

The cows were fed individually to cover the recommended requirements according to NRC (1989) allowances for dairy cattle. Concentrate mixture (CM) was fed nearly at two equal meals at 8 a.m. and 3 p.m., berseem (B) once daily at 10 a.m. and rice straw (RS) at 4 p.m. Cows were watered three times daily.

Three digestibility trails were conducted during the feeding trail using 9 cows (3 each). Cows were chosed randomly from the experimental groups to determine nutrients digestibility coefficients and nutritive values of the experimental rations using acid insoluble ash as a natural marker (Van Keulen and Young, 1977). Nutrients digestion coefficients were calculated from the equations stated by Schnider and Flatt (1975). During the digestibility trails, cows were fed their normal allowances for 15 days as a preliminary period followed by 7 days collection period. Samples of concentrate mixture, berseem and rice straw were taken at the beginning, middle and end of digestibility trail. Feces samples were taken from the rectum of each cow twice daily with 12 hours interval during the collection period. The samples of feedstuffs and feces were composted and representative samples were dried in a forced air oven at 65 °C for 48 hours, ground and then chemically analyzed to determine DM, CP, CF, EE and ash according to AOAC (1990). Calcium content of tested feedstuffs was determined by Atomic Absorption Spectrophotometer (Perkin Elmer 2380). Phosphorus was determined using Spectrophotometer (Milton Roy Company

Spectronic 20 D). Nutrients digestion coefficients were calculated from the equations stated by Schnider and Flatt (1975).

$$\text{DM digestibility (\%)} = 100 - \left[100 X \frac{\text{AIA\% in feed}}{\text{AIA\% in faeces}}\right]$$

$$\text{Nutrient digestibility (\%)} = 100 - \left[100 X \frac{\text{AI A\% in feed}}{\text{AIA\% in faeces}} X \frac{\text{nutrient \% in faeces}}{\text{nutrient \% in feed}}\right]$$

Daily milk production was recorded individually and corrected for 4% fat content (FCM) using the formula of Gains (1928) as follows:

4% FCM =[0.4 x milk yield (kg)] + [15 x fat yield (kg)].

Milk samples from the consecutive evening and morning milking were taken every week throughout the experimental period. Milk fat, protein, lactose and total solids were determined using Milko-Scan (133B. Foss Electric). Solid not fat and ash were determined by the difference. Milk fat and protein reanalyzed by Garber's and macrokjeldahle methods as described by Ling (1963).

Rumen liquor samples were taken monthly from the same cows of the digestibility trials (3 cows of each group) after 3 hours from the morning feeding using stomach tube and filtered through double layers of cheesecloth. The pH value was determined immediately using Orian 680 digital pH meter. The concentration of ammonia-N was determined using saturated solution of magnesium oxide distillation according to the method of AOAC (1990). The concentration of TVFA's was determined in rumen liquor by the steam distillation method according to Warner (1964).

Blood samples were taken monthly from the jugular vein of the cows by clean sterile needle into clean dry glass tubes using heparin as an anticoagulant, centrifuged for 15 minutes at 4000 r.p.m. to obtain plasma, which was analyzed calorimetrically for total protein, albumin, globulin (by the difference), total lipids, AST and ALT using commercial diagnostic kits (Test Combination, Pasteur Lab.).

Feed efficiency was calculated as the amounts of DM, TDN and DCP per kg 4% fat corrected milk. Economic efficiency of

milk production was calculated as the ratio between the income of 4% fat corrected milk production and the cost of feed consumption as follows:

Economic efficiency = Income of 4% fat corrected milk production / Cost of feed consumption

Where the price of 1 ton was 1000 LE for 4% fat corrected milk, 700 LE for concentrate mixture, 60 LE for fresh berseem, 50 LE for rice straw and 6 LE per kg of monosodium phosphate during the period from the beginning of January to the end of May, 2003.

Reproductive parameters as the periods from calving to the 1st postpartum estrus, 1st and 2nd insemination, conception rate for 1st and 2nd insemination, number of insemination per service, days open and conception rate during the first 90, 120 and 150 days of lactation were recorded.

The data were statistically analyzed using general linear models procedure adapted by SPSS (1999)
one-way ANOVA.

RESULTS AND DISCUSSION

Phosphorus supplementation at the rate of 0.07% improved nutrients digestion and nutritive values of tested rations (Table 2). The digestion coefficients of DM, OM, CP, CF, EE and NFE and subsequently TDN and DCP values for R2 (contained 0.43% P) were significantly higher ($P<0.05$) compared with basal diet contained 0.36% P (without P supplementation). Phosphorus supplementation at the rate of 0.15% did not significantly influenced ($P>0.05$) the digestion coefficients and nutritive value, which the differences in the digestion coefficients and nutritive value between R3 (contained 0.51% P) and basal diet were not significant ($P>0.05$). These results are in accordance with those obtained by Breves and Schroder (1991) who found that phosphorus is required by ruminal microorganisms for digestion of cellulose and synthesis of microbial protein. Durand and Komisarczuk (1988) recommended that available phosphorus within the rumen should be at least 5 g / kg of organic matter

digested to optimize degradation of cell walls from feeds by microbes.

Table 2: Effect of phosphorus supplementation on nutrients digestion and nutritive values of experimental rations.

Items	Experimental rations			
	R1	R2	R3	SE
Digestion coefficients %				
DM	63.90^{b}	64.85^{a}	64.47^{ab}	0.17
OM	64.75^{b}	65.80^{a}	65.46^{ab}	0.18
CP	62.60^{b}	64.25^{a}	63.40^{ab}	0.13
CF	58.50^{b}	60.36^{a}	59.60^{ab}	0.15
EE	74.80^{b}	76.55^{a}	75.75^{ab}	0.14
NFE	72.60^{b}	74.40^{a}	73.50^{ab}	0.16
Nutritive values %				
TDN	62.15^{b}	63.79^{a}	63.01^{ab}	0.13
DCP	8.56^{b}	8.78^{a}	8.67^{ab}	0.02

a and b: Values in the same row with different superscripts differ significantly (P<0.05).

Table 3: Effect of phosphorus supplementation on average daily feed intake of lactating Friesian cows.

Items	Experimental rations			
	R1	R2	R3	SE
Feedstuffs intake (as fed)				
Concentrate mixture (kg)	7.23^{b}	7.67^{a}	7.40^{ab}	0.03
Berseem (kg)	39.88^{b}	42.31^{a}	40.85^{ab}	0.18
Rice straw (kg)	3.67^{b}	3.90^{a}	3.76^{ab}	0.02
Monosodium phosphate (g)	-	50	100	-
DM (kg)	16.40^{b}	17.45^{a}	16.90^{ab}	0.20
TDN (kg)	10.19^{c}	11.13^{a}	10.65^{b}	0.11
DCP (kg)	1.40^{c}	1.53^{a}	1.46^{b}	0.01
Ca (g)	131.20^{c}	139.60^{a}	135.20^{b}	0.64
P (g)	59.04^{c}	75.04^{b}	86.19^{a}	2.07
Ca : P ratio	2.22:1^{a}	1.86:1^{b}	1.57:1^{c}	0.05

a, b and c: Values in the same row with different superscripts differ significantly (P<0.05).

Average daily feed intake by lactating cows fed basal ration with or without phosphorus supplementation are illustrated in Table (3). The intake of concentrate mixture, fresh berseem, rice straw and DM by cows fed R2 was significantly higher ($P<0.05$) than for those fed basal diet. However, there were no significant differences between cows fed R1 and R3 or those fed R2 and R3. moreover, cows fed R2 recorded significantly ($P<0.05$) the highest intake TDN, CP, DCP and calcium followed by those fed R3, while those in control group fed R1 had the lowest values. These results are in accordance with those obtained by Carstairs *et al.* (1981) and Wu *et al.* (2000) they found that DM intake by cows during early lactation were maximized with 0.40 to 0.42% dietary phosphorus and greater concentrations (0.50 to 0.52% P) did not increase DM intake.

Rumen liquor parameters of lactating Friesian cows as shown in Table 4 revealed that the concentration of TVFA's increased, but pH value and NH_3-N concentration decreased significantly ($P<0.05$) with the high dietary phosphorus level. The depression of ruminal pH value and ammonia-N concentration with the rise in VFA concentration with high phosphorus supplementation may be attributed to that phosphorus is essential for proper functioning of rumen microorganisms, which is required by ruminal microorganisms for fermentation and utilization of ammonia-N to synthesis microbial protein as reported by Breves and Schroder (1991). Komisarczuk *et al.* (1987) found that the reduction in phosphorus intake resulted in a significant reduction in total VFA accompanied by a rise in pH and progressively fell in ammonia-N. In spite of, cows fed R3 (0.15% P supplementation) had the higher ruminal TVFA's concentration, it recorded the lower digestion coefficients and subsequently nutritive values compared with cows fed R2 (0.07% P supplementation) as shown previously in Table (2). These results might be attributed to that high phosphorus supplementation resulted in mild diarrhea and abdominal distress (Challa et al., 1989).

The concentrations of total proteins, albumin, globulin and total lipids and the activity of AST and ALT increased significantly ($P<0.05$) in blood plasma of the lactating cows with the high dietary phosphorus level (Table 4). These results are in accordance with those obtained by Mehany (1999) who reported that blood

plasma constituents increased which mineral supplementation. Phosphorus is involved in almost every aspect of feed metabolism and utilization of fat, carbohydrate, protein and other nutrients in the body (Miller, 1983). In general both the biochemical parameters and enzymes activities fall within the normal levels of healthy lactating cattle and the hepatic function associated with the energy metabolism and seems to be not affected by phosphorus supplementation, which means that there were no harmful effects.

Table 4: Effect of phosphorus supplementation on rumen liquor parameters and blood constituents of lactating Friesian cows.

Items	Experimental rations			
	R1	R2	R3	SE
Rumen parameters				
PH	6.45^{a}	6.05^{b}	5.80^{c}	0.10
TVFA's (meq/100 ml)	12.60^{c}	14.95^{b}	16.50^{a}	0.62
NH_3-N (mg/100 ml)	24.45^{a}	20.91^{b}	18.20^{c}	1.39
Blood constituents				
Total protein (g/100 ml)	8.40^{c}	8.60^{b}	8.74^{a}	0.04
Albumin (g/100 ml)	4.35^{b}	4.47^{ab}	4.55^{a}	0.03
Globulin (g/100 ml)	4.05^{b}	4.13^{ab}	4.19^{a}	0.02
Total lipids (g/L)	5.36^{c}	7.17^{b}	9.60^{a}	0.32
AST (U /L)	16.19^{c}	19.03^{b}	21.86^{a}	0.43
ALT (U/L)	5.83^{c}	7.20^{b}	8.93^{a}	0.24

a, b and c: Values in the same row with different superscripts differ significantly ($P<0.05$).

Results in Table (5) revealed that cows fed R2 recorded significantly ($P<0.05$) the highest milk yield, 4% fat corrected milk, fat, protein, lactose, total solids and solid not fat and followed by those fed R3, while those fed R1 had the lowest values. The yield of 4% fat corrected milk of cows fed the basal ration with P supplementation (R2 and R3) increased by 15.25 and 7.69% compared with those fed the basal ration without P supplementation (R1), respectively. These results are in agreement with those obtained by Dhiman *et al.* (1996), Wu and Satter (2000), Knowlton and Herbein (2002) and Rotz *et al.* (2002) as they stated

that milk yield of cows during early lactation was maximized with 0.40 to 0.42 % dietary phosphorus, while increasing phosphorus concentration (0.50 to 0.52% P) did not increase milk yield. Carstairs *et al.* (1981) found that milk yield was not affected by the concentration of phosphorus in the diet during the first month, but from week 5 through 12 week of lactation, it tended to be greater with 0.40% compared with 0.50% phosphorus. Also, Wu *et al.* (2000) reported that for entire 84 days treatment period, cows fed 0.40% P produced 8% more milk than those fed 0.50% P. Feeding 0.42% P to high yielding cows during the first 8 weeks of lactation maximized milk production and no benefits on lactational performance of dietary P concentrations more than 0.42% were reported in any short or long term studies.

Table 5: Effect of phosphorus supplementation on milk production and composition of lactating Friesian cows.

Items	Experimental rations			
	R1	R2	R3	SE
Milk yield (kg/ day)	16.55^{c}	18.50^{a}	16.95^{b}	0.20
4% FCM (kg/ day)	14.43^{c}	16.63^{a}	15.54^{b}	0.18
Milk composition (%)				
Fat	3.14^{c}	3.32^{b}	3.44^{a}	0.05
Protein	2.35^{b}	2.43^{ab}	2.50^{a}	0.03
Lactose	3.96^{c}	4.07^{b}	4.19^{a}	0.06
Total solids	10.16^{c}	10.56^{b}	10.90^{a}	0.15
Solid not fat	7.02^{c}	7.24^{b}	7.46^{a}	0.10
Ash	0.70^{b}	0.73^{ab}	0.76^{a}	0.01
Milk constituents yield				
Fat (g/ day)	520.58^{c}	615.18^{a}	584.01^{b}	7.76
Protein (g/ day)	389.83^{c}	450.53^{a}	424.51^{b}	4.94
Lactose (g/ day)	656.29^{c}	753.93^{a}	711.13^{b}	7.25
Total solids (kg/ day)	1.68^{c}	1.95^{a}	1.85^{b}	0.07
Solid not fat (kg/ day)	1.16^{c}	1.34^{a}	1.26^{b}	0.05

a, b and c: Values in the same row with different superscripts differ significantly ($P<0.05$).

Moreover, the percentages of fat, protein, lactose, total solids, solid not fat and ash in milk increased significantly ($P<0.05$)

with increasing dietary phosphorus level. These results are in agreement with those obtained by Call *et al.* (1987), Brodison *et al.* (1989), Brintrup *et al.* (1993), Valk and Sebek (1999), Wu and Satter (2000) and Wu *et al.* (2001) they reported that the percentages of milk constituents increased with increasing dietary phosphorus contents.

Feed and economic efficiencies of lactating Friesian cows fed rations with phosphorus supplementation are shown in Table (6). Cows fed R2 had significantly ($P<0.05$) the highest feed efficiency, which recorded the lowest amounts of DM, TDN and DCP per kg 4% fat corrected milk, followed by those fed R3, while those fed R1 had the highest amounts. These results are in accordance with those obtained by Underwood (1981) who indicated that P is further involved in the control of appetite and in the efficiency of feed utilization.

Table 6: Effect of phosphorus supplementation on feed and economic efficiencies of lactating Friesian cows.

Items	Experimental rations			SE
	R1	R2	R3	
Feed efficiency				
DM kg/ kg FCM	1.14^{a}	1.05^{b}	1.09^{ab}	0.05
TDN kg/ kg FCM	0.71^{a}	0.67^{b}	0.68^{b}	0.01
DCP g/ kg FCM	97.02^{a}	92.00^{b}	93.95^{ab}	0.96
Economic efficiency				
4% FCM income (LE)	14.43^{b}	16.63^{a}	15.54^{ab}	0.18
Daily feed cost (LE)	7.64^{b}	8.40^{a}	8.42^{a}	0.10
Return of milk yield (LE)	6.79^{b}	8.23^{a}	7.12^{b}	0.15
Economic efficiency	1.89^{b}	1.98^{a}	1.84^{b}	0.02

a and b: Values in the same row with different superscripts differ significantly ($P<0.05$).

Moreover, the income and return of 4% fat corrected milk yield revealed similar trend to the yield of 4% fat corrected milk. Cows fed R2 recorded significantly ($P<0.05$) the highest income and return of 4% FCM yield, followed by those fed R3, while those fed R1 had the lowest values. However, average daily feed cost was higher significantly ($P<0.05$) for cows fed P supplementation

compared with those in control group. These results could be attributed to the cost of phosphorus supplementation. Cows fed R2 recorded significantly ($P<0.05$) the highest economic efficiency, followed by those fed R1, while those fed R3 had the lowest value. These results are in agreement with those obtained by McDowell (1992) and Knowlton *et al.* (2001).

Reproductive performance of lactating Friesian cows fed phosphorus supplementation are shown in Table (7). Phosphorus supplementation improved reproductive performance. Cows fed R2 recorded the short periods from calving to the 1st estrus, 1st insemination and days open and the lowest number of insemination per service and the highest conception rate entire the first 90 and 120 days of lactation. While, cows fed R3 recorded the short period from calving to the 2nd insemination and the highest conception rate for the 2nd insemination and entire the first 150 days of lactation. However, those fed R1 recorded the longer periods from calving to the 1st estrus, 1st and 2nd inseminations and days open and the highest number of insemination per service and the lowest conception rate for the 1st and 2nd inseminations and entire the first 90, 120 and 150 days of lactation. These results are in accordance with those obtained by McDowell (1992) who stated that the most devastating economic result of P deficiency is reproductive failure. Carstairs *et al.* (1980), Holmes (1981), McClure (1994) and Wu and Satter (2000) found that severe deficiency of dietary P caused infertility or reduced reproductive performance of cattle.

It could be concluded that phosphorus supplementation improved productive and reproductive performance of lactating cows. However, cows fed ration contained 0.43% phosphorus recorded the highest milk production, feed and economic efficiency, conception rate entire the first 90 and 120 days and the short days open. While, those fed ration contained 0.51% P recorded the highest conception rate entire the first 150 days of lactation. Moreover, the present results cleared the importance of phosphorus supplementation during feeding lactating cows on berseem alone or in a great quantities in winter season to avoid the phosphorus deficiency in berseem diet.

Table 7: Effect of phosphorus supplementation on reproductive performance of lactating Friesian cows.

Items	Experimental rations			
	R1	R2	R3	SE
Days from calving to 1st estrus	50.40[a]	42.60[b]	46.80[ab]	1.13
Days from calving to 1st insemination	94.60[a]	62.50[c]	79.30[b]	3.03
Conception rate at 1st insemination %	20.00[b]	40.00[a]	40.00[a]	8.75
Days from calving to 2nd insemination	131.37[a]	121.35[b]	117.50[b]	3.62
Conception rate at 2nd insemination %	62.50[c]	66.67[b]	83.33[a]	10.51
Days open	115.33[a]	81.00[c]	103.22[ab]	5.91
No. of insemination per conception	1.67[a]	1.50[b]	1.55[b]	0.10
Conception rate				
Entire the first 90 days of lactation	20.00[b]	40.00[a]	40.00[a]	8.75
Entire the first 120 days of lactation	40.00[b]	70.00[a]	60.00[a]	9.20
Entire the 150 days of lactation	60.00[b]	80.00[a]	90.00[a]	7.85

a, b and c: Values in the same row with different superscripts differ significantly ($P<0.05$).

REFERENCES

AOAC (1990). Association of Official Analytical Chemists. Official Methods of Analysis. 15th Ed., Washington, DC.

Breves, G. and B. Schroder (1991). Comparative aspects of gastrointestinal phosphorus metabolism. Nutr. Res. Rev., 4: 125.

Brintrup, R.; T. Mooren; U. Meyer; H. Spiekers and E. Pfeffer (1993). Effects of two levels of phosphorus intake on performance and faecal phosphorus excretion of dairy cows. J. Anim. Phyisol. Anim. Nutr., 69: 29.

Brodison, J. A.; E. A. Godall; J. D. Armstrong; D. I. Givens; F. J. Gordon; W. J. McCaughey and J. R. Todd (1989). Influence of dietary phosphorus on the performance of lactating dairy cattle. J. Agric. Sci. Camb., 112: 303.

Call, J. W.; J. E. Butcher; J. T. Blake; R. A. Smart and J. L. Shape (1987). Phosphorus influence on growth and reproduction of beef cattle. J. Anim. Sci., 47: 216.

Carstairs, J. A.; D. A. Morrow and Emery RS (1980). Postpartum reproductive function of daity cows as influenced by energy and phosphorus status. J. Anim. Sci., 51:1122.

Carstairs, J. A.; R. R. Neitzel and R. S. Emery (1981). Energy and phosphorus status as factors affecting postpartum performance and health of dairy cows. J. Dairy Sci., 64: 34.

Challa, J.; G. D. Braithwaite and M. S. Dhanoa (1989). Phosphorus homoeostasis of growing calves. J. Agric. Sci. Camb., 112: 217.

Dhiman, T. R.; L. D. Satter and R. D. Shaver (1996). Milk production and blood phosphorus concentrations of cows fed low and high dietary phosphorus. Page 105-106 in U. S. Dairy Forage Res. Center 1995 Res. Summaries, Madison, WI.

Durand, M. and S. Komisarczuk (1988). Influence of major minerals on rumen microbiota. J. Nutr., 118: 249.

Gains, W. L. (1928). The energy basis of measuring milk yield in dairy cows. University of Illinois. Agriculture Experiment Station. Bulletin No. 308.

Holmes, J. H. G. (1981). Phosphorus deficiency in cattle on the sepik plains, Papua New Guinea. Trop. Anim. Health Prod., 13: 169.

Knowlton, K. F. and J. H. Herbein (2002). Phosphorus partitioning during early lactation in dairy cows fed diets varying in phosphorus content. J. Dairy Sci., 85:1227.

Knowlton, K. F.; J. H. Herbein; M. A. Meister-Weisbarth and W. A. Wark (2001). Nitrogen and phosphorus partitioning in lactating Holstein cows fed different sources of dietary protein and phosphorus. J. Dairy Sci., 84: 1210.

Komisarczuk, S.; R. J. Merry and A. B. McAllan (1987). Effect of different levels of phosphorus on rumen microbial fermentation and synthesis determined using a continuous culture technique. British J. Nut., 57: 279.

Ling, E. R. (1963). A Textbook of Dairy Chemistry. 3rd Ed., Chompman and Hall Ltd., London.

Malmberg, M.; G.Strachan, and R. France (2003). Minerals for Beef Cattle. British Columbia Ministry of Agriculture, Food and Fisheries, M. in consultation with R. Corbett of Alberta Agriculture.

McClure, T. J. (1994). Nutritional and metabolic infertility in the cow. Oxon, UK: CAB International, Page 49.

McDowell, L. R. (1992). Minerals in animal and human nutrition. 3rd Ed. Acadimic Press, Washington, DC.

Mehany, S. B. (1999). Evaluation of some feeding systems for meat production. Ph. D. Thesis, Fac. of Agric., Cairo Univ.

Miller, W. J. (1983). Phosphorus nutrition, biochemistry, metabolism and requirement in ruminants. Paper presented at the meeting of the National Feed Ingredients Association, Chieago, Illinois, April 5-7.

Muschen, H.; A. Petri; G. Breves and E. Pfeffer (1988). Response of lactating goats to low phosphorus intake. 1- Milk yield and feceal excretion of P and Ca. J. Agric. Sci., 111: 255.

NRC (1989). Nutrient Requirements of Dairy Cattle. 6th Rev. Ed., National Academy Press, Washington, DC.

Rotz, C. A.; A. N. Sharpley; L. D. Satter; W. J. Gburek and M. A. Sanderson (2002). Production and feeding strategies for phosphorus management on dairy farms. J. Dairy Sci., 85: 3142.

Schnider, B. H. and W. P. Flatt (1975). The Evaluation of Feeds Through Digestibility Experiments. The University of Georgia Press Athens 30602.

SPSS (1999). Statistical Package for the Social Sciences. Release 10, SPSS INC, Chicago, USA.

Ternouth, J. H. (1991). The kinetics and requirements of phosphorus in ruminants. Recent advnces on the nutrition of herbivores, 15: 143.

Underwood, E. J. (1981). Mineral Nutrition of Livestock. 2nd Ed. Slough, England: Commonwealth Agricultural Bureaux.

Valk, H. and L. B. Sebek (1999). Influence of long-term feeding of limited amounts of phosphorus on dry matter intake, milk production, and body weight of dairy cows. J. Dairy Sci., 82:2157.

Van Keulen, J. and B. A. Young (1977). Evaluation of acid insoluble ash as a digestibility studies. J. Anim. Sci., 44:282.

Warner, A. C. I. (1964). Production of volatile fatty acids in the rumen, method of measurements. Nutr. Abst. Rev., 34:339.

Wu, Z. and L. D. Satter (2000). Milk production and reproductive performance of dairy cows fed two concentrations of phosphorus for two years. J. Dairy Sci., 83: 1052.

Wu, Z.; L. D. Satter and R. Sojo (2000). Milk production, reproductive performance and fecal excretion of phosphorus

by dairy cows fed three amounts of phosphorus. J. Dairy Sci., 83: 1028.

Wu, Z.; L. D. Satter; A. J. Blohowiak; R. H. Stauffacher and J. H. Wilson (2001). Milk production, estimated phosphorus excretion, and bone characteristics of dairy cows fed different amounts of phosphorus for two or three years. J. Dairy Sci.,84:1738.

الملخص العربى

تأثير إضافة الفوسفور فى العليقة على الأداء الإنتاجى و التناسلى لأبقار الفريزيان الحلابة

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أجريت هذه الدراسة على ٣٠ بقرة فريزيان حلابة بعد الولادة مباشرة لدراسة تأثير إضافة الفوسفور على الأداء الإنتاجى و التناسلى مع التغذية على البرسيم خلال فصل الشتاء. وزعت الأبقار عشوائيا إلى ثلاثة مجموعات متماثلة. غذيت أبقار المجموعة الأولى (المقارنة) على العليقة الأساسية (العليقة الأولى) التى تتكون من ٤٠٪ علف مركز + ٤٠ ٪ برسيم + ٢٠٪ قش أرز، حيث محتوى الكالسيوم و الفوسفور بها ٠,٨٠ و ٠,٣٦٪ فى المادة الجافة، على التوالى. بينما غذيت أبقار المجموعتين الثانية و الثالثة على العليقتين الثانية و الثالثة المكونين من العليقة الأساسية مضافا إليها ٥٠ و ١٠٠ جم فوسفات أحادية الصوديوم لتعطى ١٢,٥ و ٢٥,٠ جم فوسفور للبقرة فى اليوم حيث كان محتوى الفوسفور بهما ٠,٤٣ و ٠,٥١٪ فى المادة الجافة، على التوالى.

أظهرت النتائج المتحصل عليها أن الأبقار المغذاة على العليقة الثانية (المحتوية على ٠,٤٣٪ فوسفور) سجلت أعلى معاملات هضم للعناصر الغذائية و بالتالى القيم الغذائية و كذلك المأكول من المادة الجافة و المركبات الغذائية المهضومة و البروتين الخام و البروتين المهضوم.

زيادة تركيز الأحماض الدهنية الطيارة بينما تقل قيمة درجة الحموضة و تركيز نيتروجين الأمونيا فى سائل الكرش معنويا مع زيادة

مستوى الفوسفور فى العليقة، زيادة تركيز كل من البروتين الكلى و الألبيومين و الجلوبيولين و الليبيدات الكلية و نشاط أنزيمات الكبد فى بلازما الدم معنويا مع زيادة مستوى الفوسفور فى العليقة و كانت فى الحدود الطبيعية للأبقار الحلابة.

حققت الأبقار المغذاة على العليقة الثانية (المحتوية على ٠,٤٣٪ فوسفور) أعلى إنتاج من اللبن الفعلى و اللبن المعدل ٤٪ دهن و الدهن و البروتين و الجوامد الصلبة الكلية و الجوامد الصلبة اللادهنية فى اللبن. زيادة محتوى كل من الدهن و البروتين و اللاكتوز و الجوامد الصلبة الكلية و الجوامد الصلبة اللادهنية و الرماد فى اللبن مع زيادة محتوى الفوسفور فى العليقة. كذلك سجلت الأبقار المغذاة على العليقة الثانية (المحتوية على ٠,٤٣٪ فوسفور) أعلى كفاءة غذائية و اقتصادية.

أدت إضافة الفوسفور إلى تحسن الأداء التناسلى حيث سجلت الأبقار المغذاة على العليقة الثانية أقل فترة من الولادة و حتى أول شياع و أول تلقيحة و التلقيحة المخصبة و أقل عدد تلقيحات لازمة للإخصاب و أعلى معدل خصوبة خلال ٩٠، ١٢٠ يوم الأولى من موسم الحليب، بينما سجلت الأبقار المغذاة على العليقة الثالثة أقل فترة من الولادة حتى التلقيحة الثانية و أعلى معدل خصوبة من التلقيحة الثانية و خلال ١٥٠ يوم الأولى من موسم الحليب.

نستخلص أن إضافة الفوسفور فى العلائق يحسن الأداء الإنتاجى و التناسلى للأبقار الحلابة، حيث سجلت الأبقار المغذاة على العليقة المحتوية على ٠,٤٣٪ فى المادة الجافة أعلى إنتاج لبن و كفاءة غذائية و اقتصادية و معدل خصوبة. كما يوضح هذا البحث أهمية إضافة الفوسفور عند تغذية الأبقار الحلابة على البرسيم بمفرده أو بكميات كبيرة فى فصل الشتاء لتلاشى نقص الفوسفور فى البرسيم.