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NUTRITIONAL AND PHYSIOLOGICAL STUDIES ON FRIESIAN CALVES FED PROTECTED FAT AND PROTEIN DIETS: 3. HAEMATOLOGICAL PARAMETERS.

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ABSTRACT

The current work aimed to study the effect of feeding Friesian calves protected fat and protein diets on blood biochemical parameters using 18 newborn Friesian calves up to 8 months of age in 3 dietary treatment groups. The 1st group (C) was fed untreated concentrate feed mixture (CFM), the 2nd was fed the control diet in which 5% of CFM was replaced by protected fat (PF) and the 3rd was fed CFM treated with 1 % formaldehyde (protected protein, PP). Results indicated that white and red blood cells counts increased in PF and PP than C group. Frequency distribution of lymphocytes increased ($P<0.05$) and monocytes decreased in PP than PF and C groups. However, granulocytes did not differ significantly among groups. Concentration of hemoglobin and PCV % increased ($P<0.05$) in PF and PP than C group.

Keywords: Protected fat, protected protein, Friesian calves, blood haematology.

INTRODUCTION

There has been a great attention towards the inclusion of protected protein and protected fat in diets of ruminants. Incorporation of protected protein in animal diet is recommended in highly producing animals (NRC, 1984). Itabashi *et al.* (1994) and Virk *et al.* (1994) reported that protected protein increased growth rate and nitrogen retention in ruminants. Feeding protected protein results in pronounced improvement in haematological parameters of growing lambs (El-Reweny, 1999) and Friesian bulls (El-Sherbieny, 2000), which may suggest improvement of the immunity of calves during the suckling period and early ages after weaning. Also, using protected fat in ruminants feeding results in marked changes in blood constituents of Friesian bulls (Omer, 1999). The beneficial effects of protected protein and fat were reported on body weight and gain of lambs (El-Ayek *et al.*, 1999 b) and on productivity of lactating cows (Abdel-Maksoud, 1990 and EL-Ayek *et al.*, 1999 a). Yet, no available data have been reported on the effect of dietary protected protein and fat on blood picture of calves during the early stage of their life.

The present study was carried out to evaluate the effect of feeding protected protein and protected fat diets on haematological parameters of Friesian calves from birth up to 8 months of age.

MATERIALS AND METHODS

The present study was carried out at Sakha, Animal Production Research Station, belonging to the Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, and Animal Production Department, Faculty of Agriculture, Al-Mansourah University.

Animals:

A total of 18 newly born suckling Friesian calves were used in this study having an average live body weight of 47.76 kg and one month of age. Animals were divided into three similar groups, six suckling calves in each, according to their body weight. Calves in the 1st group were fed on untreated CFM and was considered as a control group. Calves were fed on untreated CFM containing protected fat in the 2nd group, and on formaldehyde-treated CFM in the 3rd group. Calves were free of any diseases with healthy appearance and they were housed in groups and were kept under semi-sheds.

Feeding system and management:

The concentrate feed mixture (CFM) used in this study was composed of 37.5% yellow corn, 20% soybean meal, 15 % corn gluten, 22.5% wheat bran, 3% molasses, 0.5% premix and 1.5% common salt. In case of calves fed protected fat diet, 5% of CFM was replaced by Magnapac (Ca-soap of fatty acids) as a dietary protected fat (PF) supplement. While, calves in protected protein diet, CFM was treated with 38-40% formaldehyde at a level of 1% on the basis of crude protein content in CFM. The Magnapac (NOREISA, Madrid, Espain) supplemented to protected fat diet contained 84% palm oil (44% palmitic, 40% oleic, 9.5% linoleic, 5% stearic and 1.5% myrstic acid), 12.5% Ca-carbonate and 3.5% moisture.Calves were allowed to suckle colostrum from their dams throughout the first three days postpartum, thereafter they were artificially suckled twice daily by drinking milk from abucket at 7.0 a.m. and 6.0 p.m. Throughout the experimental period, all calves were fed according to the recommendation of the NRC (1984) allowances on similar amounts of CFM, milk and berseem hay (*Trifolium alexandrinum*). Chemical composition of CFM, milk and berseem hay used in all experimental groups is shown in Table (1). The determined amount of CFM for treatment was mechanically grounded and sprayed by an agricultural sprayer with the recommended amount of formaldehyde (1850 ml formaldehyde/ ton CFM) according to the method described by Ferguson *et al.* (1967). During spraying the CFM was manually mingled and was stored in well tight plastic containers and left for the complete reaction of formaldehyde with crude protein in CFM for two weeks at room temperature before using in animal feeding. However, CFM (in the PF supplemented diet) was well mixed with protected fat and stored for feeding calves in protected fat diet group. Chemical analysis of representative monthly samples of foodstuffs was performed according to the official methods of the A.O.A.C. (1980).

Blood sampling:

Blood samples were taken via the jugular vein from all calves immediately before feeding at the beginning of the experiment (one month of age), thereafter at monthly intervals up to the end of the experimental period.

Table (1): Chemical analysis of feed stuffs (on dry matter basis).

Item	Feed stuff				
	CFM			Milk	BH
	Control	PF diet	PP diet		
Dry matter, DM	91.58	91.64	90.99	12.80	88.24
Organic matter, OM	90.68	89.64	90.71	94.46	88.19
Crude protein, CP	18.43	18.37	18.41	24.71	14.32
Crude fiber, CF	10.96	10.62	10.89	00	24.67
Ether extract, EE	4.91	8.52	5.01	30.50	6.04
Nitrogen free extract, NFE	56.38	52.13	56.40	39.25	43.16
Ash	9.32	10.63	9.29	5.50	11.81

Hematological parameters including count of red blood cells (RBCs) and white blood cells (WBCs) and their fractions (lymphocytes, monocytes, and granulocytes %), packed cell volume (PCV%), blood platelets count, and hemoglobin concentration were performed in fresh whole blood at different age intervals using fully digital haematology counter (Laboratories, USA).

Statistical analysis:

Statistical analysis for the obtained data was performed by the method of analysis of variance according to Snedecor and Cochran (1980) using the general linear model procedures of SAS (1987). Duncan multiple range test (Duncan, 1955) was used to determine the significant differences among age or group means.

RESULTS AND DISCUSSION

Red blood cells count (RBCs):

At all ages studied, RBCs count tended to be almost the highest in calves fed PF, followed by those fed PP, while calves fed the control diet showed the lowest values. With age progress, RBCs count was nearly similar in the control calves, while it slightly increased in calves fed PP and PF diets. It is worthy noting that RBCs count showed pronounced increase during different ages of pre-weaning ages in all calves, being higher in calves fed PF and PP than the control diets. Meanwhile, it was nearly constant in all groups with the same trend during different post-weaning ages (Table 2). Overall mean of RBCs count in calves fed PP and PF diets was significantly ($P<0.05$) higher by about 9.9 and 12.4% than those fed the control diet, respectively. However, the differences between both tested groups (PP and PF) were not significant (P?0.05).

The present count of RBCs is within the normal range and in agreement with the findings of El Sherbieny (2000) on Friesian bulls fed formaldehyde –treated CFM, El-Shabrawy (2000) on lactating cows fed heated or formaldehyde treated protein diets and El-Reweny (1999) on growing lambs fed formaldehyde –treated diets. However, the results concerning the effect of PF diet contrasted those reported by Omer (1999), who found that PF diet resulted in unaffected RBCs count. The present trend of RBCs may indicate beneficial effects of feeding growing calves on PP and PF diets

Table (2): Effect of dietary treatments on red blood cells count (x $10^6/mm^3$) in blood of calves at different ages.

Age (month)	Dietary groups		
	Control	Protected fat	Protected protein
1	10.09 ± 0.86	10.32 ± 0.93	10.12 ± 0.85
2	9.67 ± 0.95	10.75 ± 0.26	11.21 ± 0.75
3	11.07 ± 0.27	12.54 ± 0.58	11.52 ± 0.40
4	10.77 ± 0.57	10.95 ± 0.51	11.61 ± 0.32
5	10.63 ± 0.40	12.54 ± 0.28	11.72 ± 0.19
6	10.18 ± 0.54	11.91 ± 0.25	11.69 ± 0.16
7	10.23 ± 0.62	11.95 ± 0.19	11.45 ± 0.28
8	10.33 ± 0.38	12.40 ± 0.29	12.04 ± 0.20
Overall mean	10.38 ± 0.21^B	11.67 ± 0.17^A	11.41 ± 0.20^A

A & B: Group means denoted with different superscripts are significantly different at (P<0.05).

White blood cells count (WBCs):

The present results concerning group differences at different ages revealed that WBCs count was almost significantly (P<0.05) higher in calves fed PP and PF than those fed the control diet during the suckling period up to 4 months of age. However, during post-weaning periods from 4 to 8 months of age the group differences were more pronounced. Calves fed PP diet showed significantly (P<0.05) the highest count of WBCs, followed by those fed PF diet. Meanwhile, WBCs count was the lowest in the control calves. The differences were significant between all treatment groups. With age progress, WBCs count showed significant (P<0.05) increase in all groups, however, the magnitude of the increase was the highest in calves fed PP diet, followed by those fed PF diet, while the lowest occurred in the control calves. Also, it was noted that the group differences were more pronounced during different months of post-weaning period, from 4 to 8 months of age. The overall mean of WBCs count at all ages studied was significantly (P<0.05) higher by about 22.33 and 12% in calves fed PP and PF diets, respectively than in those fed the control the diet (Table 3).

The significant improvement in WBCs count in calves fed the tested diets may indicated the beneficial effects of PP and PF on haematology of calves, being higher in calves fed PP than PF diets, particularly during different months of post–weaning period. The present trend in WBCs count in calves fed PP diet at all ages agrees with those reported by El-Sherbieny (2000) on Friesian bulls and El-Ayek *et al.* (1999 a) on growing lambs. However, no significant effect was found on WBCs count in lambs fed PP diet (Mathur *et al.*, 1994). Also, WBC count was not affect by feeding Friesian bulls on PF diets (Omer, 1999).

Table (3): Effect of dietary treatments on white blood cells count ($x10^3$/ml) in blood of calves at different ages.

Age (month)	Dietary group		
	Control	Protected fat	Protected protein
1	11.02 ± 0.56^{b}	11.26 ± 0.95^{c}	11.13 ± 0.89^{c}
2	10.98 ± 1.01^{Bb}	13.10 ± 0.59^{Ac}	12.49 ± 0.38^{Ac}
3	11.65 ± 0.66^{Bb}	13.35 ± 1.03^{Ac}	13.40 ± 0.38^{Ac}
4	12.08 ± 0.76^{Bb}	14.04 ± 0.79^{Ab}	13.71 ± 0.38^{Ac}
5	$12.12 \pm .33^{Cb}$	13.27 ± 0.22^{Bc}	17.28 ± 0.4^{Aa}
6	12.0 ± 1.18^{Cab}	13.28 ± 0.25^{Bc}	16.13 ± 0.9^{Ab}
7	13.89 ± 0.40^{Ca}	16.04 ± 0.46^{Ba}	18.28 ± 1.0^{Aa}
8	13.66 ± 0.38^{Ca}	14.79 ± 0.31^{Bb}	16.79 ± 0.65^{Ab}
Overall mean	12.18 ± 0.26^{C}	13.64 ± 0.26^{B}	14.90 ± 0.42^{A}

A, B & C and a, b & c : Means having different superscripts within the same row and column, respectively, are significantly different at (P<0.05).

Frequency distribution of lymphocytes:

At different ages, the group differences in lymphocytes were found only at pre-weaning ages (2 and 3 months). Frequency distribution of lymphocytes was significantly (P<0.05) higher in calves fed PP than those fed PF and the control diets (on the overall mean basis). However, during post–weaning period from 3 up to 8 months of age, the group differences were not significant (P?0.05). With age progress, frequency distribution of lymphocytes increased to its maximum levels at 5 months of age in all groups (except PP), thereafter it showed nearly constant levels for all groups. It is of interest to note that most changes in lymphocytes count occurred at pre-weaning period. It gradually decreased in calves fed PF and control diets, while increased in those fed PP diet (Table 4). This may indicate an improvement of immunity in calves fed PP diet and, in turn, better health and growth performance, particularly during suckling period.

Table (4): Frequency distribution of lymphocytes (%) in calve groups at different ages.

Age (month)	Dietary group		
	Control	Protected fat	Protected protein
1	68.24 ± 5.12^{ab}	66.58 ± 4.26^{a}	65.26 ± 3.51^{b}
2	65.0 ± 4.89^{Bab}	56.92 ± 5.42^{Bb}	74.03 ± 2.13^{Aa}
3	49.6 ± 5.49^{Bc}	50.18 ± 4.11^{Bb}	73.40 ± 2.9^{Aab}
4	66.02 ± 6.6^{a}	68.98 ± 3.75^{a}	72.15 ± 5.71^{ab}
5	68.63 ± 2.86^{ab}	71.10 ± 1.58^{a}	65.72 ± 4.91^{b}
6	64.53 ± 3.53^{b}	68.82 ± 1.37^{a}	68.97 ± 2.19^{b}
7	63.52 ± 2.7^{b}	69.23 ± 2.45^{a}	70.48 ± 2.98^{ab}
8	69.07 ± 1.7^{ab}	70.57 ± 1.89^{a}	70.57 ± 2.1^{ab}
Overall mean	64.59 ± 1.83^{B}	65.27 ± 1.64^{B}	70.07 ± 1.58^{A}

A & B and a, b & c : Means having different superscripts within the same row and column, respectively, are significantly different at (P<0.05).

Frequency distribution of monocytes:

It is worthy noting that the significant ($P<0.05$) effect of dietary treatments on monocytes was found only among groups at 3 months of age, being higher in calves fed PF and the control diets than those fed the PP diet. This trend of differences was found at all ages studied, but the differences were not significant (Table 5). As affected by age progress, calves fed PF diet showed the highest values during pre-weaning ages. During post-weaning ages, the highest values were observed for calves fed the control diet. Meanwhile, calves fed PP diet showed the lowest values at all age studied. Monocytes showed opposite distribution to that of lymphocytes in each group at the same age (Table 4 & 5). Overall mean of monocytes distribution was significantly ($P<0.05$) higher in calves fed PF and the control diets than those fed the PP diet. This trend reversed to that in lymphocytes distribution in WBCs of the calves in all groups (Table 4 & 5).

Table (5): Frequency distribution of monocytes (%) in calve groups at different ages.

Age (month)	Dietary groups		
	Control	Protected fat	Protected protein
1	11.45 ± 1.54^{b}	11.69 ± 2.1^{b}	$9.24 \pm 0.1.9$
2	12.57 ± 1.53^{b}	16.70 ± 1.47^{a}	9.67 ± 0.52
3	15.08 ± 0.49^{Aa}	16.0 ± 1.85^{Aa}	8.63 ± 102^{B}
4	12.50 ± 4.1^{b}	11.47 ± 2.40^{b}	8.40 ± 1.78
5	12.47 ± 1.33^{b}	10.62 ± 0.86^{bc}	9.48 ± 0.87
6	13.70 ± 2.31^{a}	11.42 ± 1.64^{b}	8.77 ± 1.17
7	16.73 ± 3.1^{a}	12.92 ± 1.50^{b}	8.65 ± 0.82
8	8.52 ± 0.92^{c}	9.67 ± 0.51^{c}	7.27 ± 0.64
Overall mean	12.88 ± 0.88^{A}	12.56 ± 0.67^{A}	8.69 ± 0.40^{B}

A & B and a, b & c : Means having different superscripts within the same column and row , respectively, are significantly different at ($P<0.05$).

Frequency distribution of granulocytes:

Different trends were observed in frequency distribution of granulocytes as affected by dietary treatments with age progress. Overall mean of granulocytes distribution was higher in calves fed the control and PF diets than those fed PP diet, however, the differences were not significant (P?0.05, Table 6).

The present results indicated that the significant ($P<0.05$) effect of PP diets on increasing WBC count compared with PF and the control diets was reflected in significantly ($P<0.05$) higher distribution of lymphocytes and lower distribution of monocytes than those in calves fed PF and the control diets. While, distribution of granulocytes was not affected by different dietary treatments. No referenced data are available on the effect of PP and PF on distribution of lymphocytes, monocytes and granulocytes in the literature.

Unfortunately, there are no available data in the literature on the effect of protected protein and fat diets on frequency distribution of WBC.

Table (6): Frequency distribution of granulocytes (%) in blood of calves in different dietary treatments and at different ages.

Age (month)	Dietary groups		
	Control	Protected fat	Protected protein
1	20.31 ± 3.25^{b}	21.73 ± 3.2^{b}	22.50 ± 2.95
2	22.47 ± 3.75^{b}	26.38 ± 4.27^{b}	16.97 ± 1.52
3	35.33 ± 5.27^{a}	33.77 ± 3.45^{a}	17.92 ± 2.14
4	19.48 ± 2.1^{bc}	19.65 ± 2.44^{c}	18.97 ± 4.33
5	19.10 ± 2.2^{b}	18.28 ± 1.26^{c}	25.20 ± 4.97
6	21.77 ± 1.21^{b}	19.77 ± 0.85^{c}	25.75 ± 5.56
7	19.82 ± 1.13^{bc}	17.85 ± 1.22^{c}	17.23 ± 3.02
8	22.42 ± 2.3^{b}	19.78 ± 1.52^{c}	22.17 ± 1.71
Overall mean	22.58 ± 1.41	22.15 ± 1.20	20.84 ± 1.40

a, b and c: Means having different superscripts within the same column are significantly different at ($P<0.05$).

Count of blood platelets:

Effect of dietary treatments on platelets count was not significant at all ages studied. It is of interest to note that during pre-weaning ages, calves fed the PF diet showed the highest values. However during post-weaning ages, calves fed the PP diet showed the highest values. Also, overall mean of platelets count was the highest in calves fed PP, followed by those fed PF diet, while, the control calves showed the lowest values. The differences, however, were not significant (Table 7). No referenced data are available on the effect of PP and PF on the count of blood platelets in the literature.

Table (7): Effect of treatments on blood platelets count/mm^3 in calve groups at different ages.

Age (month)	Dietary group		
	Control	Protected fat	Protected protein
1	512 ± 65.4	536 ± 71.2	524 ± 46.9
2	495.83 ± 84.65	613.00 ± 85.60	566.17 ± 63.9
3	752.67 ± 82.14	797.33 ± 90.67	624.83 ± 37.11
4	642.67 ± 92.43	669.83 ± 97.2	$6.18.33 \pm 38.66$
5	643.33 ± 65.66	605.00 ± 49.18	592.83 ± 60.91
6	517.5 ± 62.58	471.00 ± 28.00	677.83 ± 32.64
7	413.67 ± 28.14	539.33 ± 58.01	638.83 ± 65.19
8	496.5 ± 25.75	549.83 38.10	725.67 ± 28.96
Overall mean	559.27 ± 30.8	597.67 ± 31.07	621.06 ± 18.76

Packed cell volume (%):

Calves fed the PF diet showed significantly ($P<0.05$) the highest PCV percentages during most ages studied. The differences between calves fed PF and PP were almost not significant (P?0.05) during pre-weaning ages. However, during post-weaning ages, calves fed PF diets showed the highest values, but with different trend of significance between 4 and 6 months of age. At 7 and 8 months of age, calves fed PF and PP diets sowed significantly (P<0.05) higher PCV than control calves. With age progress, PCV% showed gradual increase in all calves, but the significant (P<0.05) increase was observed between 1 and 2 months of age in calves fed PP between 3 and 4 months of age in the control calves. Generally, the highest PCV percentage was noted at 4 or 5 months of age, thereafter it slightly decreased in calves fed the control, PF and PP diets (Table 8). Overall mean of PCV% was significantly (P<0.05) the highest in calves fed the PF diet, followed by those fed the PP diet. While the control calves showed the lowest values. The group differences were significant (P<0.05). This indicated the beneficial effects of the tested diets on PCV%, being significantly (P<0.05) higher in calves fed PF and PP diets than the control calves.

Table (8): Effect of treatments on package cell volume (PCV%) in calve groups at different ages.

Age (month)	Dietary groups		
	Control	Protected fat	Protected protein
1	39.56 ± 3.70^{b}	40.15 ± 2.70^{b}	40.69 ± 2.50^{b}
2	41.93 ± 1.80^{Bb}	44.95 ± 1.45^{ABbc}	48.53 ± 2.12^{Aa}
3	41.77 ± 1.02^{Bb}	48.72 ± 3.19^{Aab}	47.98 ± 150^{Aab}
4	47.72 ± 1.74^{a}	47.02 ± 1.63^{ab}	49.58 ± 1.35^{a}
5	42.73 ± 1.53^{Bb}	49.72 ± 1.45^{Aa}	42.62 ± 2.07^{Bb}
6	41.07 ± 1.54^{Bb}	49.70 ± 1.03^{Aa}	42.17 ± 2.11^{Bb}
7	38.55 ± 0.75^{Bb}	43.50 ± 1.15^{Acd}	40.82 ± 1.57^{Ab}
8	38.55 ± 0.75^{Bb}	44.18 ± 0.73^{Acd}	41.83 ± 1.01^{Ab}
Overall mean	41.46 ± 0.79^{C}	46.00 ± 0.70^{A}	44.27 ± 0.81^{B}

A, B & C and a, b, c & d : Means having different superscripts within the same row and column, respectively, are significantly different at (P<0.05).

Haemoglobin concentration (Hb):

In spite of the insignificant differences in Hb concentration among treatment groups at all ages studied, calves fed on the PP diet showed the highest (P<0.05) overall mean value, followed by those fed on PF. While, the control calves showed the lowest values at most ages studied. Concerning the changes in Hb concentration with age progress, calves in all treatment groups showed slight increase by advancing age, being higher in calves fed the PP diet than those fed PF and the control diets. The marked differences among treatment groups were observed near weaning age at 3 months of age (Table 9).

The present results (regarding to Hb concentration) are associated with the count of RBCs (Table 2) and PCV% (Table 8) in different dietary treatment groups, indicating beneficial effect of feeding growing calves on PP and PF diets on Hb concentration as compared to the control calves, being significantly (P<0.05) higher for those fed PP than PF diet. Improvement in Hb concentration in calves fed PP diet was reported on Friesian bulls fed formaldehyde-treated CFM (El-Sherbieney, 2000) and in growing lambs fed diets containing soybean meal or line seed meal protected with formaldehyde (El-Reweny, 1999).

In general, improving the haematological parameters of calves fed PF diet may be induced by increasing level of metobolizable energy of growing calves. Similar findings were observed in calves supplemented with dietary fat (Roy *et al.*, 1970) or supplemental sources of mixture of VFA's (Metwally *et al.*, 1999).

Table (9): Effect of treatments on concentration of hemoglobin (g/100 ml) in calve groups at different ages.

Age (month)	Dietary groups		
	Control	Protected fat	Protected protein
1	9.21 ± 0.52	9.34 ± 0.62	9.12 ± 0.58
2	9.23 ± 0.43	9.80 ± 0.34	10.25 ± 0.27
3	8.08 ± 0.50	9.20 ± 0.30	10.75 ± 0.29
4	9.48 ± 0.20	9.78 ± 0.17	10.68 ± 0.40
5	10.0 ± 0.22	10.38 ± 0.22	10.73 ± 0.27
6	9.33 ± 0.23	10.50 ± 0.22	10.97 ± 0.34
7	9.27 ± 0.11	10.52 ± 0.21	11.43 ± 0.18
8	9.98 ± 0.20	10.98 ±0.23	11.70 ± 0.27
Overall mean	9.32 ± 0.14^{C}	10.06 ± 0.12^{B}	10.70 ± 0.12^{A}

A, B and C: Group means denoted with different superscripts are significantly different at (P<0.05).

REFERENCES

Abd El-Maksoud, A.M.S. (1990). Protein solubility and degradability of some treated foodstuff fed to ruminants. Ph. D. Thesis. Fac. of Agric., Fayoum, Cairo Univ., Egypt.

A.O.A.C. (1980). Official Methods of Analysis. Association of Official Analytical Chemsists. 13th Ed. Washington, USA.

Duncan, D.B. (1955). Multiple Range and Multiple F. test. Biometrices, 11:10.

El-Ayek, M.Y.; S.A. El-Ayouty; A.A. Zaki; F.F. Abo-Ammo and A. M. El-Reweny (1999 a). Response of growing lambs to feeding on total mixed rations containing formaldehyde-treated soybean meal and linseed meal. J. Agric. Sci. Mansoura Univ., 24: 3804.

El-Ayek, M.Y.; A.Z. Mehrez; S.A. El-Ayouty and A.M. El-Shabrawy (1999 b). Influence of source of protein and protection methods on the performance of lactating Friesian cows. J. Agric. Sci. Mansoura Univ., 24: 3894.

El-Reweny, A.A.S. (1999). Studies on evaluation of foodstuffs. Performance of lambs fed total mixed rations containing formaldehyde-treated soybean meal or linseed meal. M. Sc. Thesis, Fac. of Agric., El-Mansoura Univ., Egypt

El-Shabrawy, H.M. (2000). Effect of protected proteins on the milk yield. Influence of protecting cotton seed and soybean proteins by either heat or formaldehyde treatments on some metabolic and performance traits of Friesian cows. Ph. D. Thesis, Fac. of Agric., Mansoura Univ., Egypt.

El-Sherbieny, M.A.S. *(2000)*. Effect of feeding protected protein diets on reproductive performance of Friesian bulls. M. Sc. Thesis, Fac. of Agric., Mansoura Univ., Egypt.

Ferguson, K.A.; J.A. Hensleley and P.J. Reis (1967). Nutrition on wool growth. The effect of protecting dietary protein from microbial degradation in the rumen. Aust. J. Sci., 30:215.

Itabashi, H.; M. Matsumoto and T. Koboyoshi (1994). Effects of rumen by-pass trypotphan and ethanol treatment of soybeans on digestibility, nitrogen retention, urinary allonation excretion and plasma free amino acids in goats. Bulletin of National Inst. of Animal Industy, 54: 12.

Mathur, O.P.; C.S. Mathur and J.S. Bhatia (1994). Effect of feeding by-pass protein and urea on certain blood constituents in sheep. International J. Anim. Sci., 9: 2, 261.

Metwally, A.M.; E.A. Omar and A.Y. Salem (1999). Studies on some blood components, rumen fluids and growth as influenced by addition of volatile fatty acids and age of suckling Friesian calves. J. Agric. Res. Tanta Univ., 25 (1).

NRC (1984). Nutrient Requirement of Beef Cattle (6th Ed). National Academy Press, Washington, D. C.

Omer, F.M. (1999). Using protected fat prepared from soap industry by-products in finishing rations of Friesian bulls. Ph. D. Thesis. Fac. Agric., Cairo Univ.

Roy, J.H. F.; I.J.F. Stobo and H.J. Gaston (1970). Influence of source and amount of dietary fat on digestibility in young calves. Bri. J. Nutri., 24: 442.

SAS (1987). SAS User's Guide. Statistical Analysis System. Institute, Inc. Cary., NC.

Snedecor, G.W. and W.G. Cochran (1980). Statistical Methods 7th ed. Allied Pacific. Bombay, India.

Virk, A.S.; V.K. Khatta; B.O. Tewatia and P.C. Gupta (1994). Effect of formaldehyde treated faba beans on nutrient utilization and growth performance of goat kids. Small Ruminant Res., 4: 1.

دراسات غذائية وفسيولوجية على عجول فريزيان مغذاة على دهن محمى وبروتين محمى : ٣- قياسات الدم

عبد الحميد محمد عبد الحميد * ، عبد الخالق السيد عبد الخالق* ، علاء الدين فؤاد محرز**، الشافعي عبد القادر عمر** ، محمد عوض أبو الحمد**

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** معهد بحوث الإنتاج الحيوان – مركز البحوث الزراعية .

استخدم ١٨ عجل فريزيان حديث الولادة وحتى عمر ٨ أشهر ، وذلك في ثلاث معاملات غذائية ، الأولى غذيت على علف مصنع غير معامل ، والثانية غذيت على دهن محمى محل ٥ % من العلف المصنع ، بينما المجموعة الثالثة فقد غذيت على العلف المصنع لكن بعد معاملته بالفورمالدهيد (بتركيز ١ % من البروتين) لحماية بروتينه .وأشارت النتائج إلى زيادة عدد كرات الدم الحمراء والبيضاء بالتغذية على الدهن المحمى والبروتين المحمى عن المقارنة (المجموعة الأولى). وزادت كذلك نسبة كل من الخلايا الليمفاوية والأحادية بالتغذية على الدهن والبروتين المحميين مقارنة بالعليقة غير المعاملة . عموما لم تختلف نسبة الخلايا المحببة فيما بين المعاملات الثلاثة . ولقد زاد تركيز الهيموجلوبين والنسبة الحجمية لجسيمات الدم في المعاملتين ٢ ، ٣ مقارنة بالمجموعة الأولى .