U.A.R. J. Anim. Prod. Vol., **10**, No. 2, pp. 209–222 (1970).

EFFECT OF FEEDING DIFFERENT PROPORTIONS OF GREEN FODDERS OR HAY WITH CONCENTRATES ON GROWTH AND SLAUGHTER TEST FOR RABBITS

By

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One hundred and nine cross-bred (Giant flander X Baladi) rabbits of six-week old were divided into seven groups. Five groups were investigated at winter while the other two groups were at summer. Five treatments of different number of groups, were involved. Three rabbits, at every time, from only two groups were slaughtered at 6, 12 and 16 weeks of age to study the carcass portions and meat analysis.

The results may be summerized as follows:—

1. Groups fed green berseem *(Trifolium alexanderinum)* alone gave better growth data than groups fed green bersseem and concentrates.

2. Feeding green alfalfa alone, in summer, gave superior results for growth and food utilization, than feeding berseem hay plus concentrates (Starch Value, S.V., of berseem hay : concentrates ratio was 67 : 33). In addition, feeding green alfalfa showed superior results to those fed bersseem alone or berseem plus concentrates at winter (Experiment II only).

3. Feeding equal proportions of S.V. from berseem and concentrates (1 : 1) showed better results for slaughter test, the efficiency for S.V. and digestible protein intake in protein gain on boneless meat bases, than feeding bertseem alone.

4. The proximate analysis of boneless meat (Dry Matter Basis) showed a marked low fat and nearly similar ash contents than those in the literature. Samples of higher fat contained lower protein.

Rabbits could he reared on berseem (*Trifolium alexandrinum*) Solely, which is the cheapest feeding-stuff in the U.A.R. specially, in the northern part of the Nile Delta. In the out-skirts of the big cities, berseem is expensive. Therefor, cheap concentrates are sometimes used to cut down the feeding cost.

Ghoneim and El-Abbady (1961), with cross-bred Giza White × Chinchilla rabbits, recommended a diet composed of berseem and concentrates in a ratio of 1:2 from the daily allowance of starch value (S.V.). However, Raafat *et al* (1966), with Flemish giant rabbits recommended feeding and concentrates at equal proportions from the daily allowance of starch value.

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The problem of rabbit feeding, in the U.A.R., appears to be serious in summer, when shortage of suitable green fodders occurs. On the other hand, Ghoneim and El-Abbady (1959), and Touny (1960), showed that it is expensive and unsuitable for meat production to feed rabbits on full concentrate diet.

Wilson (1947), Hutchinson (1947), and Sandford (1957), indicated that the food supply influenced the carcass composition of rabbits. Increase in live weight does not indicate an increase of edible parts, therefore, slaughter test was developed in growth studies. Sandford (1957), indicated that several factors might affect the composition of rabbit meat such as slaughter age and the method of feeding.

Domestic rabbit meat is of good quality and high nutritional value for humanbeings. It contains, in general, a fairly higher percentage of protein, lower fat content than other kind of meats. It is, therefore, recommended for some sick people.

Material and Methods

Animals

The present work was undertaken at Barrage Poultry Farm, Animal Prod. Dept., Minis, of Agric.,

One hundred and nine rabbits of 6 weeks old from the crossbred, Flemish giant × Baladi red were used, 37 rabbits for the first season (Experiment I) from January to May 1963, and 72 rabbits for the second season (Experiments II and III) from January to August 1964.

Management and allocation of rabbits :

The rabbits were housed in concrete hutches. They were fed on berseem, al falfa and/or berseem-hay and concentrated rations No. 1 or 2 (Table 1). The design of experiments, groups and feeding treatments at various seasons are shown in Table 3. The green fodders were wholy offered, but the hay was cut into pieces of 1—2 cm long. Concentrate was offered at 8 a.m. and eaten up within one hour. Berseem, alfalfa and berseem hay were given from 3 to 4 times daily (from 9 a.m. to 5 p.m.). Fresh water available only for rabbits in summer time. Rabbits were individually weighed to nearest gram, before offering the morning meal at 8 a.m. every week, up to 16 weeks old.

Slaughter and analytical methods :

Representative samples of green fodders were taken bi-weekly, dried and milled. Three representative rabbits from both groups 2 and 5 were slaughtered to study the carcass composition. The rabbits at every time, were slaughtered at 6, 12 and 16 weeks of age. The boneless meat of the main

TABLE 1.—THE PERCENTAGE COMPOSITION FOR RATIONS 1 AND 2

Ration No. 1	Percentage composition	Ration No. 2	Percentage composition
Ground yellow corn . . .	32.0	Ground corn	30.0
Ground barley.	20.0	Ground barley.	30.0
Decorticated cotton seed meal	8.0	Decorticated cotton seed meal	20.0
Rice bran	20.0	Fine wheat bran	18.0
Fine wheat bran	8.0	Lime-stone	1.5
Corn glutin feed	4.0	Sodium chloride	0.5
Dried meat meal	2.4		
Dried fish meal	1.6	Total . . .	100.0
Lime-stone	1.6		
Bone meal	1.6		
Mineral mixture	0.4		
Sodium chloride	0.4		
Total . . .	100.0		

body (front and hind parts, loin and chest) was minced and well mixed. Moisture, ash and crude protein were determined from fresh samples. While samples were dried, milled and stored for the determination of ether extract. Triplicate samples were taken for analysis, using the conventional methods (A.O.A.C., 1960).

Calculation of feeding value for foods

The green fodders were bi-weekly sampled and analysed. The dry matter in the green fodders were used as a criterion for approximate estimation of their feeding value. This was necessary to determine the amount of green fodders that has to be offered daily to the experimental rabbits during the test period.

The starch values for green berseem and alfalfa were estimated using the regression equation introduced by Sultan *et al* (1966).

Starch value of green fodder % = 1 + 0.5 × dry matter % The practical starch value of berseem, alfalfa and berseem hay estimated from their proximate analysis shown in Table 2 and by using the average digestion coefficients of the nutrients of several workers.

The average moisture content of berseem was estimated for a fortnight period by averaging the moisture content of two successive weekly samples.

TABLE 2.—PROXIMATE ANALYSIS AND FEEDING VALUE FOR EXPERIMENTAL FODDERS

Fodder	Proximate analysis						Feeding value	
	Moisture	Crude protein	Ether extract	Crude fibre	Ash	N-free extract	Starch value	Digt. crude protein
	%	%	%	%	%	%	%	%
Berseem 1* . . .	85.44	2.47	0 54	3.30	1.92	6.32	8.45	1.87
Berseem 2* . . .	85.81	2.46	0.61	3.14	1.67	6.32	8.34	1.87
Alfalfa*	80.38	4.32	1.05	4.65	2.39	7.21	9.40	3.24
Berseem-hay:								
Lot. No. 1 . .	7.02	11.59	2.25	26.96	9.83	42.35	33.69	7.28
Lot. No. 2 . .	7.87	14 29	4.14	24.42	13.07	36.21	33.54	8.97
Ration 1 . . .	7.63	14.77	3.38	6.08	9.08	59.06	67.54	11.10
Ration 2 . . .	2.83	15.23	3.63	7.60	5.54	65.17	74.02	12.23

* Mean values during experimental period.

Results and Discussion

Live weight gain and relative gain

The results of the three experiments are shown in table 3. A part from group 1 and 7, the average initial live-weight was fairly similar; while it was markedly low in group 1 and high in group 7 recording 426 and 704 g. respectively. Group 3 gave the highest average final live-weight, and group 5 gave the lowest one being 1274 and 1107 g. respectively. Although groups 1 and 2 received the same feeding treatment, they gave different gain values. This may be due to some environmental conditions, seasonal variations and/or the pre-experimental treatment.

Statistical analysis was made by Radwan (1968), for the regression coefficient of growth rate (age against live-weight). The statistical data showed significant difference ($P = 0.05$) between groups 1 and 4, also between 3 and 4. Therefore, it appears that feeding 50 precent starch value of each berseem and concentrated resulted in growth retardation.

TABLE 3.— AVERAGE LIVE WEIGHT, LIVE WEIGHT GAIN AND PERCENTAGE RELATIVE GROWTH RATE FOR GROWING RABBITS BEING FED ON DIFFERENT PROPORTIONS OF GREEN FODDERS OR HAY WITH CONCENTRATES.

Expt. No.	Group. No.	Number of rabbits	Average live Weight		Total gain	Total R.G.R.*
			Initial (6 weeks old)	Final (16 weeks old)		
			g.	g.	g	%
Winter feeding						
Treatment 1.—100% S.V. berseem :						
I	1	13	426 ± 12.0	1261 ± 40.0	835	196
II	2	19	539 ± 13.9	1128 ± 44.4	589	109
Treatment 2.—67% S.V. berseem : 33% S.V. Concentrates :						
I	3	14	469 ± 19.3	1274 ± 59.6	805	172
Treatment 3.—50% S.V. berseem : 50% S.V. Concentrates :						
I	4	10	582 ± 14.5	1144 ± 49.0	562	97
II	5	21	527 ± 10.7	1107 ± 49.5	580	110
Summer feeding						
Treatment 4.—100% S.V. alfalfa :						
III	6	15	557 ± 25.7	1230 ± 43.3	673	121
Treatment 5.—67% S.V. berseem hay : 33% S.V. Concentrates :						
III	7	17	704 ± 25.7	1192 ± 37.8	488	69

* R.G.R. = relative growth rate.

The difference also, between group 4 and 6 was not significant that similar growth could be obtained when rabbits were fed berseem in winter (experiment II, group 2) or alfalfa in summer (experiment III, group 6). In this respect, Raafat *et al* (1966), and Ghoneim and El-Abbady (1961), recorded different results when feeding rabbits various proportions of berseem and concentrates.

It could, also, be seen in table 3 that feeding rabbits on green alfalfa alone gave better growth than those fed berseem hay plus concentrates, group 7.

The relative growth rate (R.G.R.) was calculated as described by Crampton and Lloyd (1959), the values in table 3 gave the same trend of the total gain for all experiments. Group 1, that received 100% berseem, showed the highest value of R.G.R. being 196% and group 7, that received berseem hay plus concentrates (67:33 S.V.) gave the lowest R.G.R. value of 69%.

Food consumption

Table 4, shows the food consumption per rabbit during the whole experimental period from 6 to 16 weeks old. The adjustment of food consumption from berseem, berseem hay, alfalfa and concentrates was practically under control to keep the same S.V. level for different treatments in each experimnt. The S.V. intake in the group 100% Berseem in each season was considered to be the refrence level for all the other treatments in the same season.

Feeding green alfalfa alone was associated with the highest digestible crude protein (D.C.P.) intake, among all other treatments (table 4) owing to the narrower nutritive ratio of green alfalfa (1:2.47). The nutritive ratio data appeared to be satisfactory as stated by Templeton (1939), who claimed that the ratio has not to be wider than 1:5.00.

The food consumption for rabbits fed berseem ad lib. seems to differ from that found by various workers in the U.A.R. (Ghoneim *et al*, 1958, 1960, Raafat *et al*, 1966 and El-Abbady *et al*, 1966).

The relationship between starch value intake and age :

The regression of weekly S.V. intake on age in weeks was statistically calculated by Radwan (1968), using pooled data for the three first treatments (groups from 1 to 5) from 6 to 16 weeks old. The regression equation $S = 22.6\ T - 43.8$ grams was obtained and proved to be significant (where S starch value intake and T the age in weeks). Generally with some approxiamtion, the rabbit from such breed would require 100 g. S.V. per week during the 7 th week of age. Then the consumption could be increased gradually by about 25 g. S.V. weekly per animal to reach about 325 g. at the 16th week.

TABLE 4.— TOTAL FOOD INTAKE, ITS NUTRITIVE RATIO AND FOOD CONVERSION PER EXPERIMENTAL RABBIT DURING THE WHOLE EXPERIMENTAL PERIOD FROM 6 TO 16 WEEKS OLD.

Expt. No.	Group No.	Total Food intake per rabbit						Food conversion	
		Green fodder or hay	Concentrates	Starch value	Crude protein	Digst. crude protein	Nutritive ratio	Total S.V. utilization*	Total C.P. conversion**
		Kg.	g.	g.	g.	g.	1	1	
Winter feeding									
Treatment 1.—100% S.V. berseem :									
I	1	25.580	—	2090	619	470	4.1	2.50	1.35
II	2	26.198	—	2003	627	477	4.1	3.40	0.94
Treatment 2.—67% S.V. berseem : 33% S.V. Concentrates :									
I	3	17.579	1073	2198	584	423	4.7	2.73	1.38
Treatment 3.—50% S.V. berseem : 50% S.V. Concentrates :									
I	4	12.241	1525	2124	517	390	5.1	3.78	1.07
II	5	13.281	1403	2116	527	410	4.6	3.65	1.10
Summer feeding									
Treatment 4.—100% S.V. alfalfa :									
III	6	19.136	—	1782	822	616	2.5	2.65	0.82
Treatment 5.—67% S.V. berseem hay : 33% S.V. Concentrates :									
III	7	3.972	1052	2116	642	435	5.2	4.34	0.76

* Gain/Starch value intake.
** Gain/Crude protein intake.

Efficiency of food utilization

The efficiency of S.V. utilization (gain/S.V.) during the whole experimental period with each group was presented in table 4, showing the highest efficiency with group 1 (1:2.50) which was fed green berseem alone and the lowest with group 7 (1:4.34) which was fed on 67% S.V. berseem hay plus 33% S.V. concentrates using Ration 2.

The efficiency of S.V. utilization in the present study with green berseem (groups 1 and 2) was higher than those with Flemish Giant rabbits obtained by Ghoneim and El-Abbady (1959), 1:4.66, Touny (1960), 1:4.79, Raafat *et al* (1966), 1:4.27 El-Abbady *et al* (1966), 1:7.00. The present data was higher also than that with Baladi rabbits obtained by Ghoneim *et al* (1958), 1:7.01. Discrepancy in those results may partly, be due to higher gain in the present study and partly, to the differences in the basic calculation of the green berseem feeding value.

The crude protein conversion was calculated as the live wieght gain obtained per unit crude protein consumed as shown in table 4. The highest value (1.38) for group 3 nearly similar to that for group 1, while the lowest value of 0.76 was for group 7, which was fed 67% berseem hay plus 33% concentrates.

Effect of feeding on slaughter data

The Definitions used for slaughter technique were those described by Radwan (1968).

Table 5, shows the average weight of body portions for growing rabbits at different ages, the percentages of body parts to the live weight and the percentages of body parts to their similars at 6 week old (initial).

At—6 weeks old, the boneless meat represented about one third of the live weight. The edible portions (liver, kidneys and heart) did not exceed than 5% of the live weight. The offalls percentage (47%) were nearly half of the live weight.

At 12 weeks old, the result of the slaughter test for group 5 (50% S.V. concentrates) was superior to group 2 (100% S.V. berseem). The results of the body parts as percentage of live weight were slightly different among the two groups.

Under the experimental conditions, it appeared that the feeding treatments slightly affected the percentage body parts of the average live weight at 12 weeks old, while the average live weight was markedly variable.

The average live weights 954 and 1017 g. for groups 2 and 5 respectively obtained in the present study, were in fair agreement with those obtained by Raafat *et al.* (1966), 1000 and 1271 g. for Flemish Giant rabbits. The higher percentage of slaughtered weight (96.93%) approached that obtained by Abou-Raya *et al.* (1966), Shawer and El Ibiary (1963).

TABLE 5.—SLAUGHTER DATA FOR VARIOUS TREATMENTS AT DIFFERENT AGES (3 RABBITS FOR EACH TREATMENT).

Age & Group No.		Live Weight	Slaughtered Weight	Dressed Weight	Boneless meat	Liver, kidneys and heart	Offals
6 *weeks (initial)*							
Body Parts in grams	(A)	612.0	589.0	238.3	193.3	28.1	287.8
Body Parts as % L. Wt†	(B)	100.00	96.19	38.92	31.57	4.60	47.00
12 *weeks old*							
Gorup 2.—100% S.V. berseem :	(A)	954.0	920.0	381.0	298.7	42.8	441.2
	(B)	100.00	96.42	39.70	31.12	4.55	46.37
% of initial weight . .	(C)	156	156	160	155	152	153
Gorup 5.—50% S. V. berseem : 50% S. V. concentrates	(A)	1017.0	986.0	416.7	335.8	45.5	469.2
	(B)	100.00	96.93	40.92	32.97	4.47	46.17
	(C)	166	167	175	174	162	163
16 *weeks old*							
Group 2	(A)	1108.0	1068.0	484.7	380.7	47.7	478.0
	(B)	100.00	96.39	43.66	34 25	4 30	43.25
	(C)	181	181	203	195	170	166
Group 5	(A)	1157.0	1121 0	526.3	448.3	44.2	488.8
	(B)	100 00	96.90	45.32	38.68	3.83	42.34
	(C)	189	190	221	232	157	170

† L. wt. = Live weight.

However, the dressing percentage of live weight (about 40%) appeared to be lower than that obtained by Khishin *et al.* (1951), with Baladi rabbits (45.3%), Shafie *et al.* (1961), with Giza rabbits (48.9%) and Shawer and El-Ibiary (1963), 41.8—45.2%.

The values for edible portions (liver, kidneys & heart) obtained by the previous authors were, generally, in fair agreement with those in the present study. The offals percentage of the live weight was similar to that obtained by shawer and El-Ibiary (1963).

The carcass data at 16 weeks old (table 5) were, generally, in agreement with those for 12 weeks.

The average results as percentage of live weight indicated, generally, that studies based on live weight would give slightly different information than those based on other body parts; e.g. the percentage of dressed weight as well as that of boneless meat, at 16 weeks old, was fairly higher than those at 12 weeks old. Therefore, as the rabbit get matured, the percentage dressed weight and boneless meat tended to increase. This would enable the producer to decide the suitable and more economical marketing age. Groups 2 and 5 were of good example, since they reached each other on live-weight basis giving values of 181 and 189 percent respectively, while they markedly differed on boneless meat basis being 195 and 232 percent correspondingly.

The average weight of the minor parts : liver, kidneys, heart, head, neck, skin, limbs and tail for both groups at different ages, were studied by Radwan (1968).

Boneless meat as affected by feed

The composition of dry boneless meat at 6 weeks old (initial age), showed lower protein and higher fat contents than at other (table 6). Generally, fat content at different ages was markedly lower than taht recorded, at similar ages, by other workers (Shafie *et al.* 1961). This was perhaps due to some specified conditions under which such experiments were undertaken. Differences were markedly obtained for protein and fat. It was noticed that samples containing higher fat had lower protein content and vice versa.

The ash content was practically nearly the same in all treatments ranging between 5.25 and 6.03%.

The calculation of physiological fuel value (table 6) was carried out considering that in human nutrition, 1 g. protein or carbohydrates equals 4 Kcal. and 1 g. fat equals 9 Kcal. The physiological fuel values in boneless meat tended to decrease as age increased up to 16 weeks, ranging between 887 and 1038 Kcal. per Kg fresh meat.

TABLE 6.—THE AVERAGE PROXIMATE ANALYSIS OF BONELESS MEAT FOR DIFFERENT TREATMENS AT DIFFERENT AGES.

Age and treatments	Moisture	Contents on D.M.B.			Physiological fuel value (calculated)	
		Protein	Ether extract	Ash	Fresh	Dry
	%	%	%	%	Kcal	kg.
6 weeks old (initial age)	76.82	79.29	15.27	5.44	1054	4547
12 weeks old						
100 % berseem	75.81	84.75	10.00	5.25	1038	4291
50 % berssem plus 50 % concentrates	77.28	88.63	5.33	6.03	915	4027
16 weeks old						
100 % berseem	77.66	88.72	5.82	5.46	909	4069
50 %berseem plus 50 % concentrates	77.70	91.03	3.72	5.25	887	3978

Results of comparing the efficiency of S.V. utilization based on protein gain (Kg. S.V./Kg. protein increase in boneless meat), revealed the superiority of feeding berseem plus concentrates to berseem alone, the calculated values at 12 weeks old being 33.72 and 41.48 Kg. respectively. The corresponding values at 16 weeks old were 38.15 and 50.18 Kg.

The values of digestible crude protein conversion based on protein gain in boneless meat (percentage of protein gain of digestible crude protein intake) were 10.17 and 14.63% for Groups 2 and 5 respectively. The corresponding values at 16 weeks old were 8.38 and 13.53%. These values indicate the superiority of feeding on berseem plus concentrates to on berseem alone.

Effect of feeding on the economical efficiency of rabbit meat production

The available data for live weight gain, dressed weight, boneless meat and protein in boneless meat of rabbits at different ages and treatments produced from 100 kg. S.V. in form of 1 ton of berseem (18% D.M., containing 10% S.V.) or 500 kg. berseem and 68 kg. concentrates (Ration 2), were

calculated and shown in Table 7. The results showed that group 5 better than group 2 at different ages. In addition, the live weight gain higher at 12 weeks old than at 16 weeks old. These results suggest that economic feeding appears to be at 12 weeks old by using a mixture berseem (500 kg.) and concentrates (68 kg.).

TABLE 7.—ECONOMICAL EFFICIENCY (EXPRESSED AS KGS GAIN PER 100 KG. S.V.) OF RABBIT MEAT PRODUCTION AT DIFFERENT AGES

Age & Group No.	Measurements				
	Live weight gain	Dressed weight	Boneless meat	Protein in boneless meat	Fresh * meat
	Kg.	Kg.	Kg.	Kg.	Kg.
12 weeks:					
Group 2 . . .	32.08	13 39	9 89	2.41	10.48
Group 5 . . .	37.53	16.53	13 21	2.96	12.87
16 weeks:					
Group 2 . . .	24.76	12.30	9.36	2.00	8.70
Group 5 . . .	25.75	13.61	12.05	2.62	11.39

* Fresh meat (according to Ghoneim, 1955) = fat and ash — free meat

$$= \frac{\text{Protein on D.M.B.} \times 100}{20}$$

Acknowledgement

Thanks are due to Dr. A. A. El-Itriby the General Director of the Animal Prod. Dept., Minis. of Agric., for his encouragement to carry out the present study. Thanks are also due to the manager of Barrage Poultry Farm (Gezeeret El-Sheer), the same Department, for providing the rabbits and facilities.

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تأثير التغذية على نسب مختلفة من الأعلاف الخضراء أو الدريس مع المواد المركزة على النمو واختبارات الذبح فى الأرانب

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الملخص

تم توزيع ١٠٩ أرنب خليط بين الجيانت فلاندر والبلدى عند عمر ٦ أسابيع على سبع مجموعات استعملت خمس مجموعات للتغذية شتاء بينما استعملت المجموعتين الباقيتين للتغذية صيفا واحتوت التجارب على خمس معاملات ذات أعداد مختلفة من المجموعات . أخذت ثلاث أرانب فى كل مرة عند عمر ٦ ، ١٢ ، ١٦ أسبوع لدراسة التصافى والتشافى وتحليل اللحم . وتتلخص النتائج فيما يلى :

١ ــ وجد أن المجموعات التى تغذت على برسيم اخضر فقط فاقت ، من حيث نتائج النمو ، المجموعات التى تغذت على برسيم أخضر مع عليقة مركزة .

٢ ــ كما أن تغذية الأرانب على برسيم حجازى اخضر فقط فى الصيف فاقت من حيث النمو والاستفادة الغذائية ، الأرانب التى تغذت على دريس برسيم بالاضافة مع مواد مركزة (معادل النشا اليومى يتكون من ٦٧٪ مصدره دريس برسيم + ٣٣٪ من مواد مركزة) . وبالاضافة الى ذلك فان التغذية على برسيم حجازى اظهرت تفوقا فى نتائجها عن التغذية على البرسيم بمفرده أو البرسيم مع العليقة المركزة وذلك بالنسبة للتجربة الثنائية .

٣ ــ بتغذية نسب متساوية من معادل النشا على هيئة برسيم ومواد مركزة وجد أن نتائج الذبح وكذلك كفاءة تحويل معادل النشا والبروتين المهضوم المأكول الى زيادة فى بروتين اللحم ، قد فاقت مثيلاتها فى حالة التغذية على برسيم أخضر فقط .

٤ ــ نتائج التحليل الكيميائى للحم (على أساس المادة الجافة) تبين منها أن نسبة الدهن كانت أعلى عما ورد فى المراجع بينما نسبة الرماد كانت متقاربة لما ذكر فى نفس المصادر ، كما لوحظ أن العينات ذات نسب عالية من الدهن احتوت على نسب منخفضة من البروتين .

(١) قسم بحوث تغذية الدواجن ــ الادارة العامة للانتاج الحيوانى ــ وزارة الزراعة ــ الدقى ــ ج.ع.م.

(٢) فرع تغذية الحيوان ــ قسم الانتاج الحيوانى بكلية الزراعة ــ جامعة القاهرة ــ ج.ع.م.