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A STUDY ON THE NET PROTEIN UTILIZATION OF BLOOD MEAL PREPARED BY DIFFERENT METHODS FOR FEEDING POULTRY

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Poultry needs a relatively high amount of animal protein in their rations. Since animal proteins are of relatively high price, therefore it is worthy to search for cheaper sources of it.

Blood represents a cheap by-product in slaughter-houses. This study deals with methods of treating fresh blood with CaO at different levels and the estimation of Net Protein Utilization (NPU) of the different mixtures comparing with Skimmilk and untreated dry blood.

Good results were recorded by mixing fresh blood with CaO at ratios of 16 : 1 and 8 : 1 respectively.

This study reveald that the mixture at a level of 8 : 1 blood to fine unslaked lime had recorded the highest NPU followed by the Skimmilk and that of 16 : 1 mixture respectively. The natural dry blood gave the fair NPU, while fresh blood gave the lowest NPU value. The NPU value recorded for the protein of Skimmilk (66.005) which is mainly casein is in a good agreament with that given by Bender and Miller, 1953 for casein only (59).

Poultry industry has become one of the most important branches of agriculture, and its futurre will depend largely on how economically poultry meat and eggs are produced.

Poultry needs a relatively high amount of protein in their diets to stand their requirements. Since protein is relatively the most important and expensive part of the diet, protein supplements should be chosen with great care.

Animal protein is usually utilized more efficiently by chichens than that of plant sources. Moreover, it has higher biological value.

A lot of work was undertaken to study the adequate daily requirements of protein for chicks to cover their needs for the different kinds of production.

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The slaughter-houses by-products are considered to be the cheaest source of animal protein, for poultry rations. Blood is the main by-product of slaughter-houses. The amount produced allover the U.A.R. was about 3 million kg as reported by The General Organisation of Food Stuffs 1963. The total amount of blood produced from slaughter-houses can be computed by multiplying the number of slaughtered animals by the average amount of blood yield per slaughtered animal according to Ghoneim, 1967.

The organic Fertilizers Company takes the responsibility of collecting the blood in Cairo. Blood is collected from the concrete floor of the slaughter-houses. Generaly after slaughtering, the cacasses of animals are washed with water before veterinary examination. This water together with blood are collected and considered as fresh blood. Its amount totaled approximatley million kg per year, (according to the report of The General Organisation of Food Stuffs, 1963). In fact blood forms only one fifth of this amount.

Fresh blood is a good source of proteins and minerals for poultry if collected and fed directly regarding proper conditions. However, there are some disadvantages which unfavours its use in poultry rations.

1. Fresh blood is a good culture for bacteria and microbes which may cause diseases to poultry if collected and offered without using proper conditions.

2. Using fresh blood in feeding chicks in some cases may cause indirectly the spread of cannibalism among chicks.

3. There are certain difficulties in getting a daily supply of fresh blood unless the slaughter-houses are near to the poultry farms or there are ways of transporting it rapidly. To overcome these difficulties it is advisable to use dried blood or blood meal for feeding poultry.

Ghoneim, (1967), reported that blood could be dried by exposing it to water steam. He mentioned three methods for drying and preparing blood meal.

The Organic Fertilizer Company dries the blood by spreading it on metal trays and exposing it to sun. This method of drying resulted in the loss of physical and chemical properties of blood, especially in summer months, where the surface layer of blood dries faster than the bottom layers as a result of the lack of mixing facilities. This increases the opportunity of the decay of these layers, and may affect badly the hygien of birds.

This directed the efforts of research workers to investigate cheap and practical mthods for producing blood meal.

In this work different methods had been undertaken to prepare air dride blood meal together with the study of U.P.P of the promising samples. Blood meal was produced by mixing fresh blood with different proportions

of fine unslaked lime which absorbed water from blood and converted to Ca $(OH)_2$, then $CaCO_3$ formed by CO_5.$CaCO_5$ can be used as a supply of Calcium carbonate for chickens.

Scrfontein, (1947), indicated that rations contained fish meal and blood meal were superior for growth than those rations contained meat meal or blood meal. In a series of experiments for growth, he found that up to 2.5% fish meal or meat meal of the rations could be replaced by blood meal.

Lockhart, Bryant and Bolin, (1949), reported that addition of isoleucine to the vaccum-dried and freeze-dried blood meals depressed growth of chicks, but not significantly, as compared with the unsupplemented blood meals. The efficiency of feed utilization was significantly depressed with the vaccum-dried meal but not with the freeze-dried blood meal when supplemented with isoleucine. The blood meals were not unplatable.

However, Alquist, (1944), stated that blood meal is a poor source of protein when fed as the cheif protein source, the addition of isoleucine produced a marked increase in growth rate.

Squibb and Braham, (1955), reported that the addition fo 3% blood meal or 0.45% L. Lysine to a basal ration resulted a significant stimulation of growth, 2—4% blood meal was most effective, 8% depressed growth.

Findrik and Dumanousky, (1957), found that blood meal-should not be used as the sole source of animal protein for chickens, best gain in weight was obtainer when one third of blood meal in in the ration was substituted by dried Skin milk.

Evans, (1960) Pointed out that although blood meal contained about 80% crude protein, it gave disappointing results in poultry rations.

Bender *et al.*, (1953), indicated that N.P.U. of casein averaged between 55—60% while it was 57% for albumin.

Summers and Fisher, (1962) reported that blood meal gave very low Net Protein Values. They added that the high percentage of collagen or gelatin (approximately 50% of the protein) as extrapolated from hydroxyproline determination was proposed as the reason for these low-values.

William and Fisher, (1963) found that good agreement was observerd between Net Protein Utilization values obtained by either the nitrogen balance or the carcass retention method in rats and chickens. The former method consistently gave higher values than the latter, and it was suggested that these differences resulted primarily from a somewhat lower protein intake (and therefore better utilization) due to equalized feeding practice with the nitrogen balance method.

This study contained the following items :—

1. The effect of adding different proportions of unslaked lime (CaO) to faresh blood on speeding the rate of drying processes and chemical composition of the products.

2. Determination of Net Protein Utilization (NPU) in the promising mixture of fresh blood and CaO compared with standard animal protein (dry skim milk).

Experimental and Methods

Methods of preparing blood mixtures :

Fresh blood was obtained daily from Cairo slaughter-house. A series of treatments were done for mixing fresh blood with fine unslaked lime (CaO) as shown in Table (1).

TABLE 1.—THE RATIO OF FRESH BLOOD TO UNSLAKED LIME TOGETHER WITH TIME OF DRYNESS AND MOISTURE CONTENT OF PRODUCTS

Treatment	Ratio of the mixtures W/W		Time needed for air drying		Moisture after drying
	blood	CaO	in winter	in summer	
			Days	Days	
1	2	1	5	3	5.02
2	3	1	6	4	5.41
3	8	1	9	6	6.89
4	16	1	12	8	7.93
5	blood alone		15	10	9.32

Mixtures of blood and CaO as well as blood were thoroughly mixed and spread into thin layers of 3—5 cm. on metal trays and exposed to the open air until the moisture content of the product has been reduced to a figure varying from 5.02—9.32.

During the whole time of drying, mixtures were turned over continuously 3—5 times daily. As regards the time needed for drying blood by exposure to the air was 3, 4, 6, 8 and 10 days, for mixtures 2:1, 3:1, 8:1, 16:1 and blood alone in summer respectively which was 5, 6, 9, 12 and 15 days for

the same mixtures respectively in winter. After being dried, mixtures were milled and stored in paper bags. A representative sample of about 250 ms. of each mixture was taken and kept in a glass stoppered jars for chemical analysis.

Birds :

The experiments were carried out with Baladi White Chicks. Chicks needed for experiment were chosen from the flock of the Experimental Station of Animal Nurition Department Faculty of Agriculture, Cairo University. This study was carried out in the hatching season, 1967. The number of chick under this erperiment totaled (120), 10 days old. The experiment lasted for three weeks. Chicks under experiment were divided into 6 groups of 20 chicks of nearly equal live weight.

Birds experimented on were kept under similar conditions of management. They were also under close veterinary supprivision and kept in warm brooders until the end of the experiment. At the end of the experiment 5 chicks were taken randomly from each group for chemical analysis.

Rations :

Six different rations (1, 2, 3, 4, 5, 6) were formulated for feeding chicks under experiment. Table (2) showed the formula of the different rations together with their chemical analysis. Rations 1, 2, 3, 4, 5, and 6 were equal in their strach value. Crude protein level was not less than 11.55% for rations 2, 3, 4, 5 and 6 ; i.e. the optimum protein level recommended by Ghoneim, (1964) for feeding Baladi chicks. According to the procedure of Bender and Miller, (1953). Ration 1 was formed of corn with total protein level, of 6.7%. The tested materials, dry blood, dry skimmilk, mixtures of blood and calcium oxide, at ratios 8:1 and fresh blood were added at certain amounts to corn grains to give nearly $\frac{1}{5}$ of the total protein of each ration. Ghoneim (1964). Each ration was supplemented with 1% Vit. A + D_3, 2% calcium carbonate and $\frac{1}{2}$ % Nacl. Calcium carbonate was added to rations, 1, 2, 3 and 6.

Management :

Chicks were raised in electrically heated batteries, each group was fed and watered *ad-lib*. Feed consumption was recorded daily. Chicks within each group individually were weighed every 3 days through the whole experimental period.

Preparing chicks for analysis :

At the end of the experiment, chicks taken randomly from each treatment were killed without bleeding using chloroform Chick's crop and the intestinal tract were cleared from residues. The whole carcasses were weighed including feathers and internal organs then dried in an open air oven till constant weight. The dry carcasses were ground and kept for the chemical analysis in tight glass containers.

TABLE 2.—THE FORMULA OF RATIONS, CHEMICAL ANALYSIS AND CALCULATED NUTRITIVE VALUE

Items	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5	Ration 6
	%	%	%	%	%	%
Ingredients:						
Corn (maize)	96.5	91.5	83.5	90.5	88.0	87.0
Natural dry blood	--	5.0	—	—	—	--
Dry skimmilk	—	—	13.0	—	—	—
8 : 1 (blood : CaO)	—	—	—	—	10.5	—
16 :1 (blood : CaO)	—	—	—	8.0	--	—
Fresh blood (dry weight)	—	—	—	--	—	10.0
Vitamin A + D_3	1.0	1.0	1.0	1.0	1.0	1.0
Calcium carbonate	2.0	2.0	2.0	--	—	2.0
Sodium chloride	0.5	0.5	0.5	.05	0.5	0.5
Chemical analysis as determined:						
Moisture	8.86	9.03	7.77	8.92	8.64	7.61
Crude protein	6.71	12.75	12.39	13.46	11.55	14.02
Ether extract	3.95	4.38	3.40	2.98	3.47	3.64
Crude fibre	3.04	3.02	2.72	2.63	2.50	2.91
Nitrogen free extract	68.78	63.93	66.18	66.67	62.69	64.72
Ash	6.66	6.89	7.54	5.34	11.15	7.05
Starch value calculated	77.20	77.43	73.94	77.20	74.70	74.40

Analytical methods :

The chemical analysis for tested mixtures and chicks carcasses were carried out on each sample following the A.O.A.C. methods, 1956.

Determination for Net Protein Utilization (NPU) :

According to Bender and Miller, (1953) procedure for the estimation of NPU which can be summarized in feeding the tested protein source in a diet to growing chicks for a certain time together with a diet either free from nitrogen or with the least minimum amount of it, then the N.P.U. can be calculated using the following equation.

$$\text{N. P. U.} = \frac{Bf - Ek + Ik}{If} \times 100$$

where Bf and If denote carcass nitrogen and nitrogen intake of animals fed test det, respectively, and B equal carcass nitrogen and nitrogen intake with the protein free control diet, respectively.

As there were some dificulty in making purified diets ; practical rations were formulated within the margin of the recommendation of Bender and Miller, (1953). Further studies using purified diets are being carried now to get more informations by the same authors.

Results and Discussion

1. *The effect of adding fresh blood to fine unslaked lime at different proportions on the chemical composition of the mixtures.*

1—1. Results in table 3 indicated that the dry matter percentages in the mixtures, ranged between (89.87-94.59), the lowest percent of moisture was given by the mixture of blood to CaO at the rates of 2:1 w/w., while the highest was given by blood alone. This showed that the prepared mixtures had the normal moisture contents of common feed stuffs and could be stored without decay. Moisture content varied between (5.02% — 9.32%),. Concerning the crude protein, its level obtained in natural dried blood was (94.34%) which was relatively similar to that of artificial dry blood (90.14%). Crude protein percentage decreased to (35.85%) and (20.99%) with the mixtures (3:1) and (2:1) blood to calcium oxide respectively. Ash content was 4.74, 8.63, 53.04, 33.34, 64.099 and 78.969% for samples no. 1, 2, 3, 4, 5 and 6 respectively as shown in Table 3.

Regarding ether extract, it ranged between 0.001 to 0.420% while it was 2.450% with dry skimmilk. Therefore according to the chemical analysis mixtures 1, 2, 3, 4 and Dry skimmilk could be considered of good value. Mixtures 5 and 6 could be considered of poor value owing to their high content of ash and low content of protein.

TABLE 3.—CHEMICAL ANALYSIS OF DIFFERENT MIXTURES OF BLOOD COMPARED WITH DRY SKIMMILK ON DRY MATTER BASES

No. of sample	Items	Dry matter	Chemical analysis as dry matter				
			Crude protein	Ether extract	Crude fibre	N.F.E.	Ash
		%	%	%	%	%	%
1	Dry blood prepared naturally	90.68	94.340	0.420	0.350	0.150	4.740
2	Artificial dry blood	91.18	90.140	0.330	0.650	0.250	3.630
3	8 : 1 blood to CaO	93.11	46.050	0.080	0.720	0.130	53.040
4	16 : 1 blood to CaO	92.07	66.030	0.020	0.550	0.060	33.340
5	3 : 1 blood to CaO	94.59	35.850	0.001	0.020	0.030	64.099
6	2 : 1 blood to CaO	94.98	20.990	0.001	0.010	0.030	78.969
7	Dry Skimmilk	89.87	38.460	2.450	—	52.43	6.66

TABLE 4.—THE WEIGHT OF CHICKS DURING THE EXPERIMENT, FOOD CONSUMPTION AND CHEMICAL ANALYSIS.

Ingredients	Treat. 1	Treat. 2	Treat. 3	Treat. 4	Treat. 5	Treat. 6
	gms.	gms.	gms.	gms.	gms.	gms.
Weight of 5 chicks of the starting expt. . . .	157	152	147	155	163	152
Weight of 5 chicks of the end	221	306	308	281	240	244
Total feed consumption	539.7	663.0	598.5	514.5	441.0	630.0
Chemical analysis of the experimental chicks						
Items						
Moisture %	2.28	2.28	2.27	2.28	3.30	4.07
Crude protein %	68.36	61.77	59.76	59.59	61.00	67.59
Ether extract %	18.57	25.60	27.67	27.48	25.19	18.62
Ash %	10.79	10.35	10.30	10.35	10.51	9.77

TABLE 5.—CALCULATED OF NPU OF THE DIFFERENT EXPERIMENTS AS DETERMINED

Ingredients	Basal	Dry blood	D.S. milk	16 : 1	8 : 1	Fresh
	1	2	3	4	5	6
Food consumption gms	529.7	663.0	598.5	514.5	441.0	630.0
Nitrogen intake gms	7.515	13.520	11.855	11.075	8.355	14.130
Carcass nitrogen gms	7.990	8.100	8.300	7.445	7.569	7.628
Net Protein Utilization % (NPU)	—	56.397	66.005	63.295	84.955	46.376

2. Estimation of NPU in the promising mixtures of fresh blood and CaO compared with standard animal protein (dried skimmilk).

Table (4) shows the weight of chicks, food consumption and chemical analysis of chicks. Group 1 was fed the least amount of protein in a practical diet (6.7% crude protein) the other 5 groups were fed the five tested proteins at equal amount according to their protein content.

By applying the method of Bender and Miller, (1953) for estimating the NPU. table (4) shows the NPU for the natural dry blood, dry skimmilk, mixture 16:1, 8:1 and fresh blood respectively.

The respective NPU. were 56.397, 66.005, 63.295, 84.955 and 46.376%.

This study revealed that the mixture at a level of (8:1) blood to fine unslaked line had recorded the highest NPU followed by the skimmilk and that of (16:1) mixture respectively. The natural dry blood gave the fair NPU, while fresh blood gave the lowest NPU value.

The NPU value recorded for the protein of skimmilk (66.005) which mainly casein is in a good agreement with the given by Bender and Miller, (1953) for casein only 59.

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دراسة مدى استفادة الكتاكيت الفعلية من بروتين الدم المحضر باضافة الجير الحى الى الدم الطازج بمستويات مختلفة

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الملخص

تحتاج الدواجن الى كميات من البروتين الحيوانى فى غذائها لتفطى احتياجها لأغراض الانتاج المختلفة ولما كان ثمن البروتين الحيوانى مرتفع نسبيا فضلا عن نقص المعروض منه لمواجهة احتياجات الدواجن يقتضى الأمر البحث عن مصادر جديدة ورخيصة من البروتينات الحيوانية للمساهمة فى سد هذا النقص ، ويعتبر الدم الناتج من الذبائح من ارخص المصادر للبروتين الحيوانى ، الا أن الأمر يستدعى الحصول على الدم بطريقة نظيفة غير ملوثة واعداده لتغذية الدواجن .

ولما كان الدم الطازج سريع التلف فقد اقتضى الأمر الى تفضيل استعمال الدم المجفف .

وقد اجريت هذه الدراسة بقسم الانتاج الحيوانى ـ فرع تغذية الحيوان ـ كلية الزراعة جامعة القاهرة ـ لدراسة افضل الطرق وانسبها لتحضير مخاليط من الدم المجفف باضافة الجير الحى الى الدم الطازج بنسب مختلفة بغية الاسراع فى عملية التجفيف ودراسة مدى استفادة الكتاكيت الفعلية من بروتين الدم المحضر باضافة الجير الحى الى الدم الطازج بمستويات مختلفة وتتلخص نتائج الدراسة فى الآتى :

١ ـ انسب نسب من خلط الجير الحى بالدم الطازج هى نسبتى ١ : ٨ ، ١ : ٦ على الترتيب .

٢ ـ تتراوح فترة التجفيف بتعريض المخاليط للجو من ٩ ـ ١٢ يوما فى الصيف بينما كانت هذه المدة بالنسبة للدم غير المعامل هى ١٥ يوما شتاء ١٠ أيام صيفا .

٣ ـ اتضح من دراسة تقدير الاستفادة الفعلية للكتاكيت من بروتين الدم المحضر أن أعلى استفادة قد حصل عليها من خلط ٨ كجم دم الى ١ كجم جير حى .