

## Respiration Trials and other Techniques for Nitrogen and Carbon Balances with Chicks

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CARBON and nitrogen balances were made in respiration trials for 3 day experimental period using both direct (carcass analysis) and indirect (Thomas — Mitchell) techniques. Diets containing 20, 16, 10 and 6% crude protein designated as treatments 1,2,3 and 4 respectively were used with Dokki "4" chicks. Results showed that increasing crude protein level in the diet increased the nitrogen retention. The values of nitrogen balance determined by indirect technique were 1.73, 1.50, 0.90 and 0.26 g, while those obtained by the direct technique were 1.11, 0.95, 0.58 and 0.19 for treatments 1,2,3 and 4 respectively. The difference value between the two techniques was 35.71 to 36.66% of nitrogen retention and from 9.61 to 19.38% of nitrogen intake.

The amount of carbon output in respiration trials throughout the 3 day experimental period in all treatments was approximately equal and may be related to the amount of carbon intake. The carbon balance per chick for this short period by the indirect technique was 1.36, 1.19, — 0.33 and 1.29 g and by the direct technique was 1.07, 0.94, — 0.26 and 1.02 g for treatments 1,2,3 and 4 respectively. Treatment 3 in both techniques recorded a negative balance suggesting that chicks may catabolize their body tissue to obtain carbon for maintenance requirements. The mean difference between both techniques was 21.04, 20.21, 21.24 and 21.34% of carbon retention and 1.29, 1.05, 0.34 and 1.61% of carbon intake for treatments 1,2,3 and 4 respectively.

Little information is reported in the literature for carbon balance studies with poultry. Schiemann *et al.* (1962) found with rats that the retention of carbon calculated by the two methods (direct and indirect) showed no significant difference, cumulative balance exceeding recovery in carcass by only 0.3 and 0.2% of intake respectively. Schiemann *et al.* (1967) using Cornish cocks found a good agreement in the values obtained in the balance studies and carcass analysis. Schiemann *et al.* (1969) found that carbon balance results and carcass analysis did not exceed 2% of intake.

Statz and Zelenj (1952) showed that 10 days as experimental period is unsuitable for measuring the capacity of an animal to retain nitrogen. Abdel-Salam (1964) with young chicks, found that the individually housed chicks showed a marked decrease in food intake and nitrogen retention in comparison with those group fed on two diets containing approximately 10 and 20% crude protein.

The balance period seems to be one of the factors affecting the nitrogen retention. This work was conducted to study the balance of carbon and nitrogen with short period in respiration

### Experimental Procedure

Four treatments were used including 20, 16, 10 and 6% crude protein. The formula of the diets is presented in details in Table 1.

A number of sixteen chicks was used in respiration technique. Four chicks were selected and divided into two equal groups in weight for every treatment. A group of two chicks (for every treatment) was killed by using chloroform, dried and kept for analysis. The other two chicks were placed individually in a respiration apparatus (Fig. 1). Every chick used for respiration trial was fed on the test diet for a preliminary period of one week before starting the experiment. The age of chicks used in these trials were as follows:

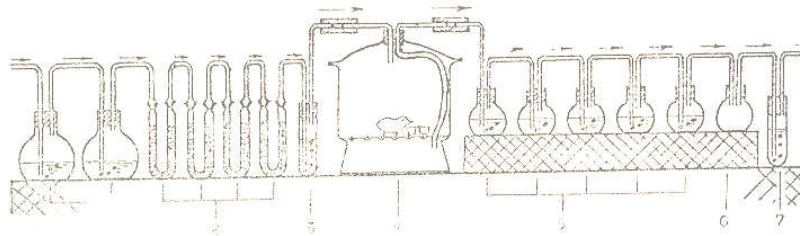


Fig. 1 — The diagrams of the apparatus employed in respiration trials :

Where : —

- 1 — Two flasks containing conc.  $H_2SO_4$ .
- 2 — Four U— tubes containing pellets of NaOH.
- 3 — Lime Water tube.
- 4 — Respiration chamber "drying dessicator".
- 5 — Five flasks containing 25 percent NaOH solution.
- 6 — Empty flask.

TABLE 1. The percentage composition of experimental diets.

Crude protein level %	20	16	10	6
Ingredients				
Maize	39.50	37.00	5.50	—
Dec. cotton seed meal	24.50	9.00	—	12.80
Fish meal	10.00	7.50	5.00	—
Rice bran	2.00	14.00	30.50	—
Barley	5.00	14.00	34.00	—
Wheat bran (fine)	4.00	11.00	10.00	—
Glucose powder	—	—	—	20.10
Starch	—	—	—	40.30
Corn oil	10.00	2.50	6.00	16.20
Cellulose powder	—	—	4.00	4.96
Mineral mixture (A)	4.70	4.70	4.70	—
Mineral mixture (B)	—	—	—	5.37
Vitamin and mineral: mixture (A)	0.20	0.20	0.20	—
Vitamin mixture (B)	—	—	—	0.07
Choline chloride 99 %	0.10	0.10	0.10	0.20

Mixtures A and B are described by Abdel-Moti (1976).

15 days for the 20 % crude protein level.

18 days for the 16 % crude protein level.

27 days for the 10 % crude protein level.

24 days for the 6 % crude protein level.

The trial lasted for 3 days (72 hrs) . The excreta was collected every 24 hr at the end of the trial , chicks were weighed, killed, dried and kept in cool place for analysis. The contents of the CO<sub>2</sub> receivers were determined (Abdel-Moti ,1976).

For carbon determination in food and faeces, the method of Klemiva and Antipova (1960) was employed.

The amount of urinary nitrogen was multiplied by the factor 2.62 (Galal, 1968) to obtain the organic matter of urine. Faecal protein was determined by using the method of Jakobson *et al.* (1960)

### Results and Discussion

#### *Nitrogen balance by direct and indirect technique in respiration trials*

The data in Table 2 and 3 show that the mean values of nitrogen balance per chick per 3 days were 0.35, 0.32, 0.35, and 0.06 g by indirect technique and 0.22, 0.20, 0.22 and 0.04 g by direct technique for treatments 1, 2, 3, and 4 respectively.

It may be seen from these data that treatment 3 (10.53% crude protein) recorded a value of nitrogen balance equal approximately with that recorded with treatment 1 (19.75% crude protein) with indirect and direct techniques. This may be due to the advanced age of the chick (27 days old) for treatment 3, while for treatment 1 the chick was 15 days old. The data also indicate that chicks fed on a high protein (19.75%) recorded the highest value for nitrogen balance data by indirect and direct techniques.

The data in Table 2 also show that the mean of nitrogen balance per chick per kg body per day were 1.73, 1.50, 0.91 and 0.26 g for treatments 1-4 respectively when nitrogen balance was determined by indirect technique, while these values were 1.11, 0.95, 0.58 and 0.19 g when nitrogen balance was determined by direct technique (Table 3).

A comparison between these results for chicks housed individually for a short period (3 days) with those fed together for a long period (16 days) by Abdel Moti (1976), indicates that values for nitrogen balance per chick per kg body weight per day, were 1.89, 1.54, 1.05 and 0.27 g for indirect technique (long period) and 1.36, 1.31, 0.78 and 0.20 for direct technique (long period).

TABLE 2. 3-day nitrogen balance determination by indirect method.

Tr. No.	Mean L. Wt. g	N-intake g	N-excreted g	N - balance /	
				chick 3-days g	kg/body wt / day g
1	66.2	0.92	0.57	0.34	1.73
2	69.7	0.96	0.64	0.32	1.50
3	127.8	0.65	0.30	0.35	0.91
4	66.7	0.21	0.15	0.06	0.26

TABLE 3. 3-day nitrogen balance determination by direct technique.

Tr. No.	Mean L.Wt. g	Initial carcass N: g	Final carcass N g	N - balance	
				Chick/3-days g	kg body wt / day g
1	66.2	1.54	1.76	0.22	1.11
2	69.7	1.77	1.97	0.20	0.95
3	127.8	3.11	3.33	0.22	0.58
4	66.7	1.58	1.62	0.04	0.19

It could be concluded that both short experimental period and also individually housed chicks are in favour of giving lower values with nitrogen balance studied.

When comparing the nitrogen balance in both direct and indirect techniques (Table 4), it may be seen that the balance by carcass analysis recorded a lower value than the data obtained by indirect technique. The causes of discrepancies were already discussed by Abdel-Moti (1967).

#### *Carbon balance by direct and indirect techniques*

The data in Table 5 show that the amount of carbon output in respiration trials throughout short period in all treatments was approximately equal and may be related to the amount of carbon intake.

TABLE 4. A comparison between 3-day nitrogen balance data by direct and indirect techniques.

Tr. No.	N-intake g	N-balance		Differ- ence	% Difference related to	
		direct g	indirect g		retention	intake
1	0.92	0.22	0.35	0.13	36.52	13.95
2	0.96	0.20	0.32	0.12	36.81	12.35
3	0.65	0.22	0.35	0.13	65.71	19.38
4	0.21	0.04	0.06	0.02	36.66	9.61

TABLE 5. 3-day carbon balance data by indirect technique in respiration trials.

Tr. No.	Mean of. L.wt g	C. intake g	C-output		C-balance per	
			Respiration g	Excreta g	Chick/3day g	kg/body wt. /day g
1	66.2	22.93	10.77	10.80	1.36	6.66
2	69.7	22.97	10.77	11.01	1.19	5.68
3	127.8	20.59	11.58	9.34	-0.33	-0.86
4	66.7	17.34	11.61	4.41	1.29	6.43

Results also show that the carbon balance data per chick for 3-day period recorded a higher mean value of 1.36 for treatment 1 when compared with treatment 2 (1.19g) and 4 (1.29g). Treatment 3 recorded a negative carbon balance value (-0.33g) suggesting that chicks may catabolize their body tissue to obtain carbon for maintenance requirement.

Results in Table 6 show that the values of carbon balance per kg body weight per day for treatment 1, 2 and 4 were 5.39, 4.53 and 5.07 g respectively, while for treatment 3 a negative balance of 0.68g was recorded. These results were of a similar trend of those in Table 5.

Table 7 shows the carbon balance data determined by both techniques (direct and indirect) during 3-day period. It may be seen that the values obtained by the indirect technique were higher than those obtained by the direct technique in all treatments.

TABLE 6. 3-day carbon balance data by direct technique in respiration trials

Tr. No.	Mean of l.wt. g	Initial carcass C g	Final carcass C g	C. balance per	
				chick 3-days g	kg/body wt./day g
1	66.2	15.88	16.99	1.07	5.39
2	69.7	17.02	17.96	0.94	4.53
3	127.8	31.97	31.71	-0.26	-0.68
4	66.7	19.83	18.81	1.02	5.07

TABLE 7. A comparison between 3-day carbon balance data by direct and indirect techniques in respiration trials.

Tr. No.	C-intake g	C. balance		Difference g	% difference related to	
		direct g	indirect g		Retention	intake
1	22.93	1.07	1.36	0.29	21.04	1.29
2	22.97	0.95	1.19	0.24	20.21	1.05
3	50.59	-0.26	-0.33	-0.07	21.24	0.34
4	17.34	1.02	1.29	0.27	21.34	1.61

The mean difference between both techniques ranged from 20.21 to 21.34% of carbon retention and from 0.34 to 1.61% of carbon intake. Comparing these results with the results in Table 4 which are measuring the mean difference between both techniques in nitrogen balance, carbon retention or carbon intake recorded lower values. Probably, there is a small irregular error which may be cumulative in carbon balance and the values obtained for the mean difference percent of carbon intake can be considered a reasonable agreement.

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### استخدام تجارب التنفس وبعض الطرق الأخرى في تقدير ميزان الأروت والكربون باستخدام الكناكيت

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قدر ميزان الكربون والأزوت من خلال تجارب تنفس استمرت ثلاثة أيام بالطريقة المباشرة (carcass analysis) والطريقة الغير مباشرة (Thomas-Mitchel) استخدمت أربعة مستويات من البروتين تحتوى على ٢٠ ، ١٦ ، ١٠ و ٦٪ العليقة رفعت نسبة الأزوت المحتجز وكانت أرقام ميزان الأروت بالطريقة الغير مباشرة هي ١٧٣ ، ١٥٠ ، ٩٠ ، ٢٦- بينما الأرقام المتحصل عليها بالطريقة المباشرة كانت ١١١ ، ٩٥ ، ٥٨ ، ١٩- للمستويات السابقة للبروتين على الترتيب ، ويتراوح الفرق بين الطريقتين من ٣٥٧١ الى ٢٦٦٦٪ المحتجز ، من ٩٦ الى ١٩٢٨ من الأزوت المأكول ، كانت كمية الكربون الخارجة في تجربة التنفس خلال مدة التجربة ( ثلاثة أيام في جميع المعاملات متساوية تقريبا وربما يكون لذلك علاقة بكمية الكربون المأكول . وكان ميزان الكربون لكل كتكوت بالطريقة الغير مباشرة ١٣٦ ، ١١٩ ، ٢٣ ، ١٢٩ جرام بالطريقة المباشرة ١٠٧ ، ٩٤ ، ٢٦ ، ١٠٢ جرام للمستويات السابقة للبروتين على الترتيب ، وقد لوحظ أن المستوى الثالث من البروتين سجل رقما ساليا في كلا الطريقتين مشيرا بذلك الى أن الكناكيت ربما كانت تهدم من أجسامها للحصول على الكربون اللازم لعمليات حفظ الحياة وكان متوسط الفرق بين الطريقتين ٢١٠٤ ، ٢٠٢١ ، ٢١٢٤ ، ٢١٣٤٪ منسوبا للكربون المحتجز ١٢٩ ، ١٠٥ ، ١٣٤ ، ١٦١٪ منسوبا للكربون المأكول .