



STUDY ON ENERGY AND PROTEIN DISTRIBUTION FOR EGG MASS PRODUCTION IN GUINEA FOWLS LAYERS USING THE SYSTEM 'CLARCS OF DISTRIBUTION/TRANSFORMATION'

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ABSTRACT

Aim: To introduce and calculate the energy and crude protein distribution from fodder to the edible part of the egg mass. New indexes "Clarc of energy distribution (CED)" and "Clarc of protein transformation (CPT)" were introduced. **Methods:** The "Clarc's" were calculated by using the following formula: $CED = \frac{\text{Total energy content in the yolk, albumen, mélange}}{\text{Total metabolizable energy intake for 1 kg yolk, albumen, mélange}}$; $CPT = \frac{\text{Total (crude) protein content in yolk, albumen, mélange}}{\text{Total (crude) protein intake for 1 kg yolk, albumen, mélange}}$. **Results:** CDE to the yolk, albumen, mélange – 0.1492, 0.0399 and 0.1891 respectively; CPT to the yolk, albumen, mélange – 0.1041, 0.113, 0.2771 respectively.

Key words: Clarc of energy distribution, Clarc of protein transformation, eggs, fodder, Guinea-fowls

INTRODUCTION

The reasons for domesticating Guinea-fowl and its rearing under intensive farming in a number of countries are the good culinary and dietary qualities of the meat and eggs, bird unpretentiousness to the living conditions and the high resistance to all the diseases typical of other farm birds (1, 2). The increased consumer demand for healthy foods produced on small farms, and the search for new sources of income by the farmers have stimulated the research on that avian species in recent years (3).

The species is characterized by high egg-laying intensity (4).

Guinea fowl meat and eggs have specific dietary and taste qualities (5, 6). Guinea fowl eggs are dietary products having low cholesterol content and hypoallergenic property. They have a very thick shell, they are easily transportable and the chance of salmonella contamination is almost zero. Their valuable properties and freshness are preserved for up to six months at 0-10 °C. Eggs are rich

in vitamins (D, E, B group, PP), minerals (phosphorus, fluorine, copper, iron, molybdenum, manganese, sulfur, silicon, zinc, calcium, iron, potassium, etc.) and amino acids (lysine, methionine, glutamine, asparagine, cysteine). The yolk is bright in colour (almost orange) and contains carotenoids and provitamin A. The rich protein content makes them highly nutritious (7, 8) found out that, compared to hen eggs, the eggs of Guinea fowl are rich in crude protein: 54.1 vs 45.9%; iron: 7.8 vs 3.32 ppm; potassium: 0.34 vs 0.28% for the two species, respectively. According to the same author, the yolk in which the main valuable nutrients are concentrated, is relatively larger compared to the eggs of hens (31 versus 28.2%).

With regard to the quantitative and qualitative composition of fatty acids, cholesterol, amino acids, and oligo- and trace elements, guinea fowl eggs are like a nutritional supplement to a much higher degree than quail and pheasant eggs (9). Those eggs are more expensive for consumption compared to hen and the egg production is less developed as the efforts are concentrated on higher meat production.

The purpose of the present study was to investigate the net-efficiency of the transformation of metabolizable energy and crude protein along the feed-egg chain in guinea fowls, using the newly introduced Clarc of

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energy transformation/protein distribution system.

The birds were reared in a free-range system, in light-type polymer premises open to free range yards and fed on compound feed for guinea-fowl laying hens, containing 11.73 MJ/kg ME and 16.5% CP (**Table 1**).

MATERIAL AND METHODS

The experiment was carried out with 75 pear-gray guinea fowl hens of a local population.

Table 1. *Composition and nutritional levels of the combined fodder for Guinea fowls - layers*

Compounds - %	
Maize	30.00
Wheat	30.00
Soybean meal 44% CP	20.32
Sunflower meal 34% CP	6.00
L-lysine HCL	0.17
DL-methionine	0.15
Chalk	8.14
Calcium phosphate	1.95
Salt	0.12
Vit.-Min.-Premix	0.65
Sunflower oil	2.50
Content in 1 kg	
ME, MJ	11.73
Crude protein, %	16.50
Lysine - %	0.80
Met.+cystine - %	0.75
Treonine - %	0.71
Tryptophan - %	0.16
Ca - %	4.02
P, avail. (poultry) - %	0.44
Na - %	0.18

The investigation was conducted over two productive years (2016 and 2017). The following characteristics were studied: the period of reaching 10% of egg-laying capacity, egg-laying intensity, the length of the egg-laying period, and the average laying capacity of the birds.

Daily control of egg production was performed during the experiment and the egg weight was measured with OHAUS-2000 electronic scale with an accuracy of 0.1 g.

Feed conversion ratio (FCR) per egg and per 1 kg of egg weight was calculated on the basis of the results of feed consumption and the egg mass-produced during the egg-laying period and averaged by years and for the entire experimental period.

The yolk, protein, and shell weights of 744 eggs (about 7% of all the eggs laid) having an average weight for the period, were measured separately. A chemical analysis was performed using the standard Weende method (10) with

20 common samples of the measured eggs (10 per egg-laying season).

For the calculating of the Clarks of energy distribution (CED) and protein transformation (CPT), the following formula was used (11):

$CED = \text{MJ gross energy (GE) obtained from 1 layer (given by egg white/yolk) / MJ metabolizable energy (ME) consumed for the whole egg laying period}$

$CPT = \text{kg crude protein (CP) obtained from 1 layer (given by egg white/yolk) / kg CP consumed for the whole egg laying period}$

RESULTS AND DISCUSSION

Table 2 shows the average data for the two egg-laying seasons for the feed, metabolizable energy, and crude protein intake by a layer for a full egg-laying period. Combined feed for the entire egg-laying period after 22 weeks of age had the same composition, the birds controlling the intake of nutrients themselves, the variations being from 85 to 105 g/day (12).

Table 2. Consumed combined fodder (kg), metabolizable energy (MJ) and crude protein (kg) from 1 layer for the whole laying period

Indexes	LS	SE
Consumed fodder – kg	17.55	0.51
Consumed metabolizable energy (ME) – MJ	205.89	6.02
Consumed crude protein (CP) – kg	2.90	0.08
Egg laying period – days	217	-

The average egg weight per layer, calculated as the product of the mean number of eggs laid and the mean weight of an egg is presented in **Table 3**. Taking into account the data available, both for the laying capacity (13 - 16) and for the average egg weight (8, 15, 17), we consider that the total egg mass-produced in the present study corresponded to the average data cited in the literature.

Similar results were obtained about the egg yolk and albumen produced per season by one layer.

Data for crude protein and gross energy content in the yolk and albumen, obtained in the present study, are similar to those reported by (8) and (18).

Table 3. Produced egg mass, egg white, egg yolk from 1 layer for the whole laying period and content of gross energy (GE) and crude protein (CP) in egg white and yolk

Indexes (mean for the egg laying period)	LS	SE
Produced egg mass from 1 layer – kg	5.97	0.53
Produced egg white mass from 1 layer – kg	2.93	0.0378
Produced egg yolk mass from 1 layer – kg	1.94	0.0227
Mean content of CP in egg white - %	11.13	0.10
Mean content of CP in egg yolk - %	15.53	0.10
Mean content of GE in egg white – MJ/kg	2.80	0.03
Mean content of GE in egg yolk – MJ/kg	15.86	0.11

Table 4 shows the energy and protein content in the edible parts of the egg produced by a single layer, as well as the Clarc of energy distribution (CED) and protein transformation (CPT) to the albumen, yolk and egg mélange. On the basis of the feed consumed and the average content of metabolizable energy and crude protein, we calculated the values per

layer for the whole egg-laying period, i.e. 205.89 MJ and 2.90 kg, respectively.

Although, due to the high water content, the absolute amounts of the produced albumen are higher than yolk (Table 3), the distribution of both energy and protein in particular from feed, is less efficient in the albumen than in the yolk (**Table 4**).

Table 4. Produced absolute amounts of gross energy and crude protein from 1 layer for laying period and Clarc of distribution/transformation of the energy/protein (CED, CPT)

Indexes (from 1 layer for the whole egg laying period)	LS	SE
Produced gross energy from egg white – MJ	8.2128	0.1059
Produced gross energy from egg yolk – MJ	30.7231	0.3599
Produced crude protein egg white – kg	0.3265	0.0042
Produced crude protein egg yolk – kg	0.3008	0.0035
Clarc of energy distribution – fodder-egg white	0.0399 (3.99%)	-
Clarc of energy distribution – fodder-egg yolk	0.1492 (14.92%)	-
Clarc of energy distribution – fodder-egg mélange	0.1891 (18.91%)	-
Clarc of (crude) protein transformation – fodder-egg white	0.113 (11.30%)	-
Clarc of (crude) protein transformation – fodder-egg yolk	0.1041 (10.41%)	-
Clarc of (crude) protein transformation – fodder-egg mélange	0.2171 (21.71%)	-

The CED and CPT calculations in egg mélange (**Table 4**) showed a relatively high

transformation efficiency of the studied components. The efficiency of protein

transformation was about 22% higher, with its distribution to the albumen and yolk being relatively even, while the distribution of energy from feed to mélange was about 19%, but mainly at the expense of the distribution to the yolk (about 15%) while to the albumen, it was about 4%. That is a result of the higher fat content of the yolk.

CONCLUSIONS

For the whole egg-laying period (mean 217 days) one layer is consumed mean 17.55 kg combined fodder, 205.89 MJ metabolizable energy, and 2.90 kg crude protein.

The output of gross energy and crude protein from 1 layer with the egg mélange is respectively 38.9359 MJ (8.2128 MJ with the albumen and 30.7231 MJ with the yolk) and 0.6273 kg (0.3265 kg with the albumen and 0.3008 kg with the yolk).

The following Clarc's of distribution/transformation are established:

Clarc of energy distribution

- fodder-egg white - 0.0399 (3.99%)
- fodder-egg yolk - 0.1492 (14.92%)
- fodder-egg mélange - 0.1891 (18.91%)

Clarc of (crude) protein transformation

- fodder-egg white - 0.113 (11.30%)
- fodder-egg yolk - 0.1041 (10.41%)
- fodder-egg mélange - 0.2171 (21.71%)

The proposed Clarc's could be used in three directions:

- Ecological – to measure the real transformation of the nutrients under the different levels of the ecological (eco – technical) trophic chain (plant – animal).
- Selection – to select animals with the better transformation of the substances/nutrients
- Technological – to find technological decisions for the better transformation of fodders to animal production.

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