



*Original Contribution*

**INFLUENCE OF THE CEREAL COMPONENTS REPLACEMENT WITH EXTRUDED BREAD WASTE IN THE LAYING HENS DIET ON THE NET UTILIZATION OF ENERGY AND PROTEIN**

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**ABSTRACT**

Aim: Monitoring the effect of the replacement of 5 and 10% of the grain component in compound feed for laying hens with the same amount of extruded bread waste on Clarc of energy distribution (CED)/protein transformation (CPT) in the eco-technical chain "fodder - egg mélange".

Experimental design: Three groups: 50 layers each (hybrid Lohman Klassic Brown), one – control, one – replacement of 5% of the grain, one - replacement of 10% of the grain with extruded bread waste.

Results: CED "ME fodder – GE mélange": control – 0.2064; 5% bread wastes – 0.2049; 10% bread wastes – 0.2166.

CPT "CP fodder - CP mélange": control – 0.2538; 5% bread wastes – 0.2585; 10% bread waste - 0.2838.

There is a tendency for higher net utilization of energy and protein from feed to the egg mélange in the group receiving 10% bread wastes.

**Key words:** bread wastes, Clarc of energy distribution, Clarc of protein transformation, layers

**INTRODUCTION**

Food Waste (both precooked and leftover) is a biodegradable waste discharged from various sources: food processing industries; households; hospitality sector (1). FAO reported that nearly 1.3 billion tonnes of food including fresh vegetables, fruits, meat, bakery, and dairy products are lost along the food supply chain (2). Food waste has a high nutritional value. Thrown out to the environment, it causes ecological pollution (3, 4). Bread and others paste after expiration date can be used after extrusion in compound feed for non-ruminants and poultry (5, 6). Except to the beneficial ecological effects of their using, the bread waste inclusion in compound feeds for non-ruminants and poultry will save grain components (7, 8).

The net utilization of energy and protein in the chain "feed-food" has been objective of scientific interest in the recent years. In this

regard, the feed conversion ratio as a main indicator of nutrient's utilization in poultry no longer meets modern requirements (9-11). Penkov and Genchev (9) suggested the introduction of objective criteria Clarc of energy distribution (CED) and Clarc of protein/amino acids transformation (CPT), and Penkov and Grigorova (12) adapted the calculation of these indicators for laying poultry.

The aim of the current study is to investigate the effect of cereal component replacement (5% and 10%) in the compound feed of laying hens with extruded bread waste on Clarc of energy distribution/protein transformation in the eco-technical chain "fodder – egg mélange".

**MATERIAL AND METHODS**

An experiment was conducted in the period February-April 2020 at the Poultry Experimental Center of Institute of Animal Science-Kostinbrod with a total of 150 laying hens (35 weeks old) from Lohman Klassik Brown hybrid. At the beginning of the experiment the poultry were randomly distributed into three groups (control and two

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experimental groups) in separate boxes, 50 layers each. The hens were housed on a deep litter pen on a 16 h lighting schedule. The compound feed of the control group had following composition: maize; soybean meal; sunflower meal; sunflower oil; limestone; monocalcium phosphate; salt; L lysine; mineral premix and vitamin premix. A part of the grain component in the feed of the experimental groups was replaced with 5% (I experimental group) and 10% (II experimental group) extruded bread waste. The diets of all groups had the same nutritional value: 11.31 MJ metabolizable energy; 18% crude protein; 4.5% crude fats; 4% crude fiber; 12.14% crude ash; 3.55% Ca; 0.54% P. All the groups received 130g feed/day/hen. The duration of the experiment was 60 days.

The laying capacity (%), the health status of the birds, the feed provided and the fodder rests were monitored daily. At the beginning and end of the experimental period, the following measurements were made on 30 eggs per group: masses of egg, egg yolk, egg white and shell with the sub-shell (with an electronic scale with an accuracy of  $\pm 0.01$ g). Chemical analysis of egg white and yolk was made on 6 eggs per group, with a mass close to the average. The chemical composition of feed and eggs was determined by the Weende method (14). The

metabolic energy of the feed was established according to (15). The gross energy in egg melange was calculated according to the formula of (16). The Clares of energy distribution (CED) / protein transformation (CPT) were calculated by the original formula (13):

CED = Consumed ME from 1 layer/produced GE through the egg white/yolk/mélange

CPT = Consumed CP from 1 layer/produced CP through the egg white/yolk/mélange

## RESULTS AND DISCUSSION

The indexes of the entrance of the eco – technical system are shown in **Table 1**. The average daily fodder consumption ranged between 126 and 128 grams. The birds from the first experimental group have consumed lowest feed, followed by the control, and the highest consumption has been observed by the birds from the group with 10% bread waste. On this basis, the amounts of metabolizable energy received in the body of one layer - 86.673MJ (control), 86.619 MJ (I experimental) and 86.895 MJ (II experimental group) and crude protein - respectively 1.355, 1.354 and 1.375 kg, were calculated. The differences in the feed amounts received are not significant ( $P > 0.05$ ) for both energy and protein.

**Table 1.** Consumed amounts of feed, metabolizable energy and crude protein on average from the laying hen for the whole experiment (entrance of the system)

Indexes	Control group	I-st exper.with 5% bread wastes	2-nd exper.with 10% bread wastes
Consumed feed – kg	7.575 $\pm$ 0.22	7.570 $\pm$ 0.28	7.683 $\pm$ 0.25
Consumed metabolizable energy– MJ	86.673 $\pm$ 2.48	85.619 $\pm$ 3.17	86.895 $\pm$ 2.82
Consumed crude protein – kg	1.355 $\pm$ 0.039	1.354 $\pm$ 0.036	1.375 $\pm$ 0.038

Chemical composition of egg albumen and egg yolk of the hens from all the groups is shown in **Table 2**. Significant higher protein content in the egg yolk ( $P < 0.05$ ) and egg albumen ( $P < 0.05$ ) in the layers from II experimental group in comparison with the control and I experimental group was established. These results may be explained with the higher protein digestibility of compound feed with 10% extruded bread waste. Using methods for balance experiments, (17) determined the coefficient of true digestibility of protein (CTDP=84.15) and apparent metabolizable energy - zero corrected (Men-o) = 14.17MJ/kg

DM in bread wastes from Bulgarian bakery industry.

There is not significant difference ( $P > 0.05$ ) of albumen and yolk chemical composition between control and I experimental group.

The accumulated gross energy per unit protein and yolk was also significantly higher ( $P < 0.05$ ) in the eggs of the second experimental group compared to the control, but between the two experimental groups, the differences are not significant.

**Table 2.** Chemical composition and metabolizable energy (ME) in egg albumen and egg yolk of hens from control and experimental groups

Indexes	Control group	With 5% bread wastes	With 10% bread wastes
Egg white			
Crude protein (CP) %	10.95 ± 0.28*	11.05 ± 0.37a	12.50 ± 0.41*a
Crude fats, %	0.54 ± 0.02	0.40 ± 0.01	0.30 ± 0.01
NPE %	0.50 ± 0.02	0.20 ± 0.01	0.42 ± 0.02
Gross energy (GE), MJ/kg	5.87 ± 0.08*	5.60 ± 0.08a	6.34 ± 0.12*a
Egg yolk			
Crude protein (CP)%	16.23 ± 0.35*	17.07 ± 0.48	17.48 ± 0.37*
Crude fats, %	30.26 ± 0.47	30.95 ± 0.23	31.07 ± 0.57
NPE %	0.25 ± 0.01	0.00	0.00
ME – MJ/kg	15.05 ± 0.25*	15.46 ± 0.32	15.93 ± 0.45*

Notice: \*-\*Significant between control and experimental groups by  $P \leq 0.05$

a-a Significant between the experimental groups by  $P \leq 0.05$

The accumulated amounts of gross energy and crude protein in the produced proteins and yolks on average from one layer for the whole experiment in all the groups and the Clarks of energy distribution / protein transformation are presented in **Table 3**.

For both yolks and albumens, despite not significantly differences, there is a trend, the group receiving feed with 10% bread wastes to produce more crude protein and gross energy

compared to both the control and the group with 5% bread waste. This trend is mainly due to a significantly ( $P < 0.05$ ) higher content of crude protein in the edible parts of the eggs. Due to the fact that the hens in this group consumed (although insignificant) more feed (respectively metabolizable energy and crude protein), the differences in the indexes reflecting the biotransformation along the chain "feed - egg mélange" are statistically insignificant ( $P > 0.05$ ).

**Table 3.** Produced gross energy (GE) and crude protein (CP) from one layer for the whole experimental period and Clarks of energy distribution (CED)/ protein transformation (CPT)

Indexes	Control group	With 5% bread wastes	With 10% bread wastes
Produced CP with the egg white – kg	0.22 ± 0.01	0.22 ± 0.01	0.25 ± 0.02
Produced CP with the egg yolk – kg	0.13 ± 0.01	0.13 ± 0.01	0.14 ± 0.01
Produced GE with the egg white – MJ	5.87 ± 0.08	5.60 ± 0.08	6.34 ± 0.12
Produced GE with the egg yolk – MJ	12.02 ± 0.21	11.94 ± 0.19	12.48 ± 0.39
Clark of energy distribution „ME fodder– GE white“	0.0677 ± 0.008 (6.77%)	0.0654 ± 0.006 (6.54%)	0.0730 ± 0.008 (7.30)
Clark of energy distribution „ME fodder– GE yolk“	0.1387 ± 0.011 (13.87%)	0.1395 ± 0.010 (13.95%)	0.1436 ± 0.015 (14.36%)
Clark of energy distribution „ME fodder– GE mélange“	0.2064 ± 0.01 (20.64%)	0.2049 ± 0.009 (20.49%)	0.2166 ± 0.011 (21.66%)
Clark of protein transformation „CP fodder– CP white“	0.1624 ± 0.01 (16.24%)	0.1625 ± 0.01 (16.25%)	0.1819 ± 0.01 (18.19%)
Clark of protein transformation „CP fodder– CP yolk“	0.0959 ± 0.01 (9.59%)	0.0960 ± 0.01 (9.60%)	0.1019 ± 0.01 (10.19%)
Clark of protein transformation „CP fodder– CP mélange“	0.2583 ± 0.01 (25.83%)	0.2585 ± 0.01 (25.85%)	0.2838 ± 0.01 (28.38%)

However, the trend of higher net utilization (higher Clarks) of energy and protein in the group with included 10% bread waste compared to the other two groups is of interest for further research. The calculated CED and CPT in the

present study are compatible with those obtained by us in experiments with the same hybrid (13), but with different aims and experimental design.

## CONCLUSIONS

The following values for the net utilization of the energy and the protein have been observed:

-For the Clarc of energy distribution (CED):

-fodder – egg white: control group – 0.0677; 5% bread wastes – 0.0654; 10% bread wastes – 0.0730  
- fodder – egg yolk: control group – 0.1387; 5% bread wastes – 0.1395; 10% bread wastes – 0.1436  
-fodder – egg mélange: control group – 0.2064; 5% bread wastes – 0.2049; 10% bread wastes – 0.2166.

-For the Clarc of protein transformation (CPT):

-fodder – egg white: control group – 0.1624; 5% bread wastes – 0.1625; 10% bread wastes – 0.1819  
-fodder – egg yolk: control group – 0.0959; 5% bread wastes – 0.0960; 10% bread wastes – 0.1019  
-fodder – egg mélange: control group – 0.2583; 5% bread wastes – 0.2585; 10% bread wastes – 0.2838.

There is a tendency for higher net utilization of energy and protein from feed to the egg mélange in the group receiving 10% bread wastes.

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