THE FEED VALUE OF TRITICALE COMPARED TO THE CORN

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Abstract. *The experiment analyzed the value of new feeds: triticale and corn (Tuxpeno and opaque-2) which were compared with Romanian corn HS-400. The inherent experimental disagreements, some inconclusive data and unclear were resolved by appropriate statistical calculation, by establishing CS and EPEF and the AMMI biplot and finally by costs. The obtained results revealed the value of the triticale mixture, which was similar to the opq-2 mixture but it was high superior in cost evaluation (higher 60%).*

Keywords: Triticale and corn forages, Robro-70 broiler chicken, growth, economic parameters, cost price.

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1. Introduction

Arne Müntzing's (1973) dilemma regarding the use of different forms of triticale as animal feed [23] has been resolved. Today, triticale has become a useful product for both humans and animals. However, experiments with new cultivars and new recipes will continue.

We are witnessing an explosion of information advocating the food and feed value of triticales [12, 22], claims which necessitate further research [24, 28, 26].

The limits of triticale's use in different forms have yet to be reached. More and more data has appeared in specialized literature supporting this statement [5, 9].
A great advantage of Triticale is its whole meal use in healthy food products [7]. When compared to other countries (Poland, Hungary, Russia), the triticale market in Romania is poorly developed.

The use of triticale-based feeds remains fairly controversial; there is still a debate on the economic efficiency in feeding different species with it and the effectiveness of different recipes. It is almost unanimously agreed that feeding poultry (broilers and turkeys) with triticale-based feeds has given the best results [13].

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In our study, the value of the triticale line Tim-5 was analyzed in comparison with the efficiency of corn-based feeds (HS-400, Tuxpeno and Opaque2), each of which was recommended for growing broilers [18, 1, 2, 8].

2. Materials and Methods

This study aimed to assess the value of triticale feed in comparison to normal corn (Simple Hybrid HS-400, Tuxpeno landrace and the lysine&tryptophan-rich Opaque 2 variety. In the study, Rubro-70 broiler chicks were used as test subject.

2.1. The cereals used in the experiment

Triticale Tim-5 (Tim-5) was created at Timişoara Agronomic Institute, Genetics Department, by Dr. Gallia Butnaru and submitted for approval in 1972. Tim-5 was chosen for its superior yield (over 8,000 kg/ha in the University's experimental field), and for its superior energy value. Thus, at milk-wax maturity, the net energy value from carbohydrates was significantly higher (35,391 net energy MJ/ha**) than that of wheat (with 24,205 net energy MJ/ha) and rye (with 22,981 net energy MJ/ha). At full maturity, the energy value of cellulose was also significantly higher (79,576 net energy MJ/ha*) than that of wheat (59,554 net energy MJ/ha), but lower than that of rye (80,761 net energy MJ/ha), being 98.53% of it. Triticale is a good source of phosphorus and magnesium and a very good source of manganese. It is valuable for its content of B vitamins, especially thiamine and folate [13]. The amino acid content of triticale varies from 0.157 g to 1,184 g and 4,006 g/100 g of product (Tryptophan, Proline and Glutamic Acid, respectively [25].

The **Simple Hybrid 400** (**HS-400**) was created in Romania, at the Lovrin Research Station, Banat County, by Dr. Titus Suba. It is preferred by farmers as a common feed for poultry and pigs. It is a productive maize hybrid (9,000 kg/ha non-irrigated crop and 12,000 irrigated crop), with 1-2 large cobs, yellow-orange and dent grains, hard and good quality endosperm: protein over 11.2%, starch 70.4% and fat 4.8% [21]. The large and dent seeds are difficult to be swallowed by small chicks. For this reason, it is usually used as grounded feed.

Tuxpeno corn (TUX) a native crop of Virginia, introduced by Prof. Dr. Mihai Ioniţă, was recommended for its rapid growth, 2-3 large cobs, white and dent kernels, soft endosperm and especially for its nutritional value. The massive energy value of this feed is due to its high content of complex carbohydrates, B vitamins (thiamine and niacin), the presence of minerals (magnesium and phosphorus) that support the growth of muscles and bones of the chicks [20, 4].

Opaque-2 corn (opq-2), introduced by Dr. Gabriel Nedelea, is rich in lysine and tryptophan, which make it a nutritionally superior food. It has yellow kernels,

indicating a higher concentration of carotenoids, especially zeaxanthin and a strong antioxidant effect. Opaque corn proteins have less zein (15-27%) than regular corn (54-59%). The endosperm is soft and it has been recommended for feeding poultry, pigs and small animals [8, 10, 17, 16].
At the time of the '80s year experiment, selected corn hybrids had been extensively studied and were also recommended in feeding broilers experiments. In the same time the knowledge regarding the effectiveness of triticales in feeding broilers was unknown. Testing feed recipes prepared from different cereals was done on Robro-70 broilers, a breed recommended for this type of experiments.

2.2. Growing conditions for Robro-70 broilers

One day after hatching, 100 chicks, of approximately equal weight (aprox. 45g), were selected and organized into 4 batches of 25 individuals each. Their development was tracked into two periods 1-35 days (or the first stage or intensive growing) and 36-49 days (or the second stage, finishing stage) respectively; i.e. 5 and 7 weeks.

The feed recipe was recommended by the Poultry Department of our university. It was a mixture of 50% standard feed 1 and standard feed 2 for the first and second growth stages, respectively, and 50% HS-400 corn meal (as control) meal from Tuxpeno and Opaque-2 corns, against which the meal of the triticale line Tim-5 was evaluated.

Throughout the entire experimental period, the broilers were fed ad libitum with the 4 types of feed. Broiler rearing took place in standard IAT cages (Fig. 1). The growth temperature was maintained by incandescent lamps at 35ºC in the first 7 days and 25-27ºC throughout the second experimental period. The lighting of the shelter was nearly constant, to stimulate the pineal gland and thus ensure additional feed consumption.

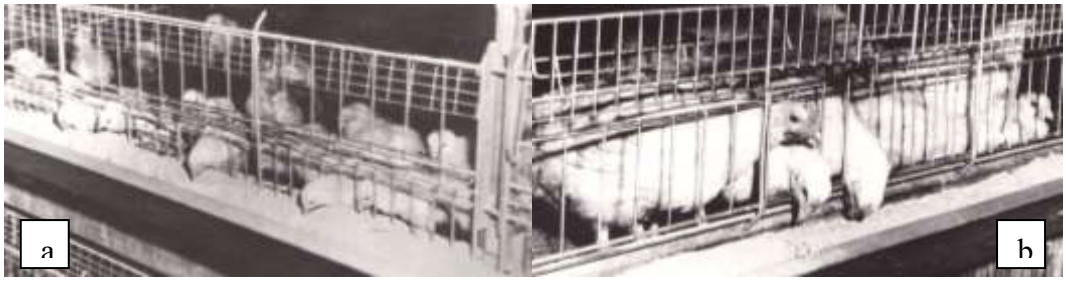


Photo 1. General aspect of rising and the feeding at 3-day-old (a) and at 49-day-old (b) chicks and chickens respectively

The experiment was conducted at the Experimental Farm of the Agronomic Institute Timișoara (1988).

The experimental data has not been published yet. The work was presented as a poster at the 12th International Triticale Symposium, May 30 – June 3, 2025, at Gansu Agricultural University, Lanzhou R. P. China.

2.3. Statistical analysis

Weight gain of broiler chickens was recorded at 5 weeks and 7 weeks respectively. At each stage, the yield of each feed recipe was evaluated, thus establishing the specific feed consumption for one kilogram of weight gain (specific consumption/kg growth), the cost of feed for reaching one kg of live weight (lei/kg); the cost of feed for one kg of growth. The economic parameters of the line Tim-5 and the corn varieties were established by specific calculation [15]. The data for chicks of chicken's growth parameters were analyzed by ANOVA method [14], while the mean were compared using Last Significant Difference Test as described by Ciulca [6]. To display the parameters of the cultivars over each growth period in a single graph, the basic principle of the biplot technique [11] and GGE biplot method [27] were used (Fig. 2).

3. Results and Discussions

3. 1.Results

3.1.1. The Raising Robro-70 broilers

The growth of Robro-70 broilers was monitored in two stages: the first period, comprising of days 1- 35 (i.e. the first 5 weeks), and the second period, comprising days 36 - 49 (i.e. the 6th and 7th weeks) (Table 1).

Table 1. Weight gain (g) of Robro-70 broiler fed with triticale and corn mixtures in the first 5 and 7 weeks

Standard feed supplemented with 50% grains of:	**The weight of chicks and chickens (g):**			
	5 weeks	**7 weeks**	**Mean**	**Total**
HS-400	806 ab ^{X}	574 b ^{Y}	690 B	1,380
Tim-5	782 b^{X}	597 b ^{Y}	690 B	1,380
Tuxpeno	824 a ^{X}	651 a ^{Y}	738 A	1,475
opaque-2	781 b ^{X}	600 b ^{Y}	691 B	1,381

• Different letters (a, b, c) in the column indicate significant differences ($p < 0.05$) between forage types for each period; •• Different superscript letters (x, y) in the row indicate significant differences ($p < 0.05$) between period for each forage; ••• Capital letters were used for forage mean (A, B) comparisons.

According to the data in Table 1, the weight gain of Robro-70 broilers in the first period of growth recorded values between 781 g in the case of feeding with opq-2 corn and 824 g in the case of feeding with TUX. During the first period, feeding with TUX corn resulted in a significant increase by 42-43 g, as compared to feeding with Tim-5 and opq-2. For all four types of feed, it was observed that, in

the first period, the growth rate of broilers was significantly higher with relative deviations ranging between 26.57% for TUX and 40.42% for HS400.

In the second period, the growth ranged from 574 g for the HS-400 based feed to 651 g for the TUX feed. In this period too, it is observed that the TUX corn-based food resulted in a significant increase in the weight of the chicks when compared to the other types of feed.

It is found that the growth gain differences in the first stage decreased in the second one.

At the end of the experimental period, the chickens had an average weight that did not clearly differentiate any type of feed. TUX corn feed insured an average weight of 1,475 kg, being superior by +95 g to the HS-400 control. Tim-5 forage pointed out the same growth as at control.

Taking into account the chicken's growth the efficiency of different feeds, it was ranked each type of feed as follows: TUX with 1,475 kg, opq-2 with 1,381 kg, HS-400 with 1,380 Kg and Tim-5 with 1,380 kg.

Basically the 4 feeds are much the same in feed value.

3.1.2. Specific consumption (SC)

Regarding specific consumption (SC; Table 2) in the first growth period of Robro-70 broilers, the variation amplitude was between 1,928 kg for feeding with TUX mixture and 2,038 kg for feeding with Tim-5 triticale.

Table 2. Specific feed consumption of the tested cultivars used in broiler breeding Robro-70

The tested cultivar	Forage specific consumption (kg)		
	5 weeks	7 weeks	Mean
HS400	1,945 ab ^{Y}	2,253 a ^{X}	2,099 A
Triticale Tim-5	2,038 a ^{X}	2,069 bc ^{X}	2,054 AB
Tuxpeno	1,928 b ^{X}	1,980 c ^{X}	1,954 B
opaque-2	2,022 a ^{X}	2,152 ab ^{X}	2,087 A

• The letters (a, b, c) in the column indicate significant difference ($p < 0.05$) between forage types; •• Different superscript letters (x, y) in the row indicate significant differences ($p < 0.05$) between period for specific forage; ••• Capital letters were used for forage mean (A, B) comparisons.

Thus, the use of TUX corn in feeding resulted in a significant reduction in SC as compared to the feeds based on opq-2 corn and Tim-5 triticale.

The specific feed intake for the finishing period ranged from 1,985 kg for TUX forage to 2,253 kg for HS-400. Feeding Tim-5 mixture led to an important reduction in the specific intake when compared to control (-3%).

The variation in SC from one period to another was found reduced and insignificant regardless of the type of feed used.

Table 3. Specific consumption (CSg/100g) per 100g live weight of Robro-70 chickens in the stages I and II and throughout the entire period

The mixture of:	First stage	Second stage	The entire period
HS-400	241.32a	392.51a	304.21 A
Tim-5	260.61a	346.57bc	297.69 AB
Tuxpeno	233.98b	304.15c	264.76 B
Opaque 2	258.90a	358.67ab	379.15 A

The CSg/100g analysis (Table 3) highlighted the value of each feed. Thus, the mixture TUX had the most favorable use, 264.76g/100g growth respectively, significantly differentiating from the other feeds. In the first stage the CS of the triticale was the highest (260.61g/100g) being significant different from the mixture with TUX but without significant difference from control (HS-400) and opaque-2.

In the finishing stage, the triticale feed ensured a good growth of the Robro-70 chicks; consumption was moderate 346.57g/100g respectively, slightly differentiated from the TUX mixture and significant differentiated from control.

Per entire period triticale forage had ensured a good growth of Robro-70 hybrid with moderate feed consumption and with a significant difference to the control. Compared to the standard feed, HS-400, the triticale mixture proved to be more efficient.

3.1.3. The European Efficiency Factor (EPEF)

The European Production Efficiency Factor (EPEF) established the nutritional value of the different feeds used in our experiment (Table 4).

Table 4. The European Efficiency Factor (EPEF), established for the forages used in experiment

The mixture of	EPEF	Value Classes
HS-400	32.87	low
Tim-5	33.56	good
TUX	37.74	the best
opq-2	33.08	good

Classes: >35; 30-35 medium; <30 low

The best efficiency was highlighted by the TUX mixture (37.74). Good efficiency was also recorded by triticale and opq2 feeds (33.56 and 33.08 respectively). A

low efficiency was recorded by HS400 feeds (32.87). The EPEF pointed out feed value of Tim-5 mixture which was consistent with our aim.
From this point of view, we recommend the Tim-5 mixture in feeding broiler chickens**.**

3. 1.4. Cost price of feed

Regarding the mean cost price of the feed used, in the first period, there was variation from 1.26 lei/kg, in the case of using Tim-5, to 1.98 lei/kg, in the case of all corn-based feed ($p<0.05$; Table 5). The evident difference was in the second period when the forage cost varied from 1.41 lei/kg to the 2.14 lei/kg at Tim-5 and HS-400 forages respectively.

Regarding the cost of feed for one kilogram of live weight gain in the first growth period, values between 2.24 lei (triticale Tim-5) and 3.66 lei (opaque-2) were recorded.

For the second period, the feed price was between 2.92 lei/kg for triticale and 4.82 lei/kg for HS-400 corn cultivar. In both periods, triticale-based feed had a significantly lower price, by 35-40% compared to corn-based feed.

Table 5. Forage and growth costs of Robro-70 broiler chickens fed with corn and triticale in the first 5 weeks and during the finishing period

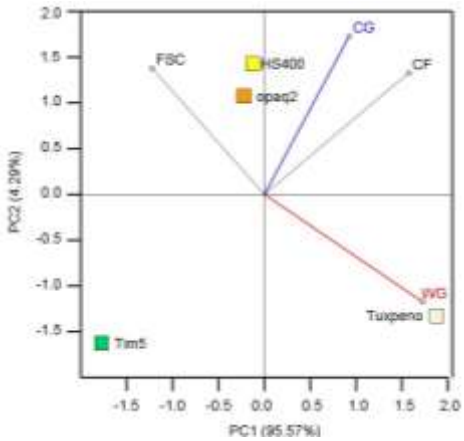
Cultivar	Cost (lei/kg forage)			Cost (lei/kg growth)		
	5 weeks	7 weeks	Mean	5 weeks	7 weeks	Mean
HS-400	1.81 a ^{X}	2.14 a ^{X}	1.98 A	3.52 a ^{Y}	4.82 a ^{X}	3.09 A
Triticale Tim-5	1.10 b ^{X}	1.41 b ^{X}	1.26 B	2.24 b ^{X}	2.92 b ^{X}	2.11 B
Tuxpeno	1.81 a ^{X}	2.14 a ^{X}	1.98 A	3.48 a ^{X}	4.23 a ^{X}	2.72 A
opaque-2	1.81 a ^{X}	2.14 a ^{X}	1.98 A	3.66 a ^{Y}	4.60 a ^{X}	2.93 A

• Different letters (a, b) in the column indicate significant differences ($p < 0.05$) between cultivar for each period; •• Different superscript letters (x, y) in the row indicate significant differences ($p < 0.05$) between period for each cultivar; ••• Capital letters were used for cultivars mean (A, B) comparisons.

Regardless of the growing period, the Tim-5 triticale-based feed had superior efficiency due to a reduction in the cost price/kg of growth by 31-40%.

3.1.5. Highlighting the efficiency of different types of feed using the AMMI biplot method

The efficiency of the triticale line Tim-5 compared to the most appreciated corn cultivars in the growth of Robro-70 broiler birds was highlighted by generating the AMMI biplot diagram (Figure 1).



• WG-weight gain (kg/animal); • FSC-Forage specific consumption (kg); • CF-Cost (lei/kg forage); • CG-Cost (lei/kg growth).

Fig. 1. Biplot of first two principal components for efficiency indicators of forage types used for growth of Robro-70 broiler chickens

Based on average values of growth gain and specific consumption triticale Tim5 forage pointed out superior economic efficiency to feed based on corn.

Tuxpeno corn-based feed they ensured the highest growth gains associated with the lowest specific consumption and average feed costs. The HS400 and Opaque 2 corn-based feeds had low efficiency associated with great specific consumption, low growth gains and high costs.

3.2. Discussions

Like other triticale varieties Tim-5 revealed good nutritive value as a suitable feed for broilers [26, 3]. In terms of weight gain, feeding with the triticale mixture ensured a similar increase to opq2 corn.

In terms of chicken' weight gain feeding with the triticale mixture ensured a similar increase to opq-2 corn [12]. Both opq-2 and triticale are rich in lysine and tryptophan, have a high content of B vitamins (thiamine and niacin), contain Mg and Ph the elements necessary for chicken growth. During the finishing stage both were superior to the control HS-400 corn.

Our data show that the efficiency of assimilation of triticale and opq-2 feeds was lower in the first stage of growth than that of the other two maize varieties. There are not data why the quantity of feed consumed for 1 kg of weight gain was higher for, Tim-5 and opq-2 (+93g and +77g, respectively).

During the second period, the specific consumption was lower for both mixtures Tim-5 and opq2 (-184g and -101g, respectively). This downward trend in specific

consumption has not been analyzed in other experiments. We hypothesize that for both feeds, the enzymatic system of broilers needed an adaptation period.

We consider that the two types of feed (triticale and opq-2) are very different from usual corn, which represents a barrier to their correct evaluation. A higher efficiency of triticale and opq-2 assimilation could be ensured by a period of "adaptation" of the entire digestion chain and thus the enzymatic equipment would be adapted for the new feeds. This supposition was highlighted by a better use of them in the second growth stage. Only recently it has been a discussion about the need of a time lag for the new feeds [19].

Across both periods of growth, the cost of Tim-5 was the lowest of all the feeds in the experiment. In comparison to HS-400 (control), the cost price per kilogram of broilers fed on triticale was lower by 63.64% and 60.58% for the first and second periods, respectively. Compared to opq-2 corn, the cost price of triticale was also lower by 61.20% and 63.34%, respectively, for both growth periods.

Conclusions

(1) Triticale-based feeds are recommended for broilers because it has a nutritional value similar to the opq-2 corn the variety with the most valuable aminoacid content.
(2) The cost price (in lei) of one kilogram of product was almost by 60% lower than the control and opq-2 corn.
(3) Due to its similarity to opq-2 corn, triticale, Tim-5, can be considered a valuable feed.
(4) For its high yield, significantly lower price, good quality, the good EPEF factor and implicit the SC, an ease cultivation, good yield, low reaction to the climate changes, we recommend to use triticale forage in chicken dietary.

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