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EFFICIENCY OF USING THE NEW DOMESTIC MEAT-EGG HYBRID FOR THE PRODUCTION OF FOOD EGGS IN HOUSEHOLD FARMS

S.M. Pankova, O.O. Katerinich

State Poultry Research Station NAAS
Birky, Zmiev district, Kharkiv region, Ukraine, 63421
e-mail: svet_my@ukr.net

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Aim. A detailed analysis of the egg production and economic efficiency of using a new dual-purpose hybrid in a comparative aspect with the original forms. **Methods.** Standard zootechnical methods of estimating body weight, egg production and its intensity, egg weight, feed costs and livability of adult hybrid and purebred hens were used. The effects of heterosis on the main utility indicators and the European profit ratio IOFC (Income Over Feed Cost), which displays the difference between the revenue from one layer and the cost of consumed food, was estimated. **Results.** Almost all studied indicators demonstrated the advantage of the hybrid over the original forms. The phenomenon of heterosis was observed in most studied indices – 5.7 % by precocity, 3–7 % by mass of eggs, 12–14 % by egg production. Early puberty (on 2–16 days), more intensive build-up of egg production (by 3.3–4.2 %), improvement of its medium intensity by 4.6–9.8 % provided by hybrid laying hens per year of life which were 9–20 eggs superior than the origin forms. Due to the high productivity and low feed consumption per 10 eggs (2.1 kg versus 2.8 kg for the paternal form), the profit ratio IOFC was also 28.7–29.1 % higher for a hybrid. This indicates the expediency of using layers of a new hybrid combination for the production of food eggs in farming and household farms. **Conclusions**. The obtained zootechnical and economic indicators demonstrate the expediency of using layers of a new hybrid combination for the production of food eggs in farming and household farms.

Keywords: dual purpose bird, hybrid, egg productivity, economic efficiency, original form.

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INTRODUCTION

Poultry breeding is a relevant component of agriculture in almost the whole world. In recent years, the global poultry breeding in general and a relevant Ukrainian industry in particular have witnessed an increasing share of consumable goods production (eggs and meat of different breeds of poultry) due to the development of small and medium-size farms and small holdings of the population [1]. This is related to the fact that poultry is a relevant source of animal protein and can be bred in situations with limited feeds and other resources. In addition, in rural areas, poultry ensures food safety, family income and plays a relevant role in socio-cultural life of peasants.

Broiler and layer strains are in the greatest demand among the population, as they have the advantageous combination of egg production and egg weight, sufficient for the household, with the added value of fine meat qualities. This poultry may be of special interest for organic farms with alternative methods of breeding. In the global market, dual purpose chickens are presented by such selection companies as Lohmann Tierzucht, Geflügelzucht Hölzl, Hetzenecker Küken (Germany) [2], Novogen Groupe Grimaud (France) [3, 4], which mostly obtain hybrids after interbreeding boiler and layer strains with a dwarfing gene [5].

At the same time, the optimal variant for the population is breeding local breeds and populations, which, though less productive than industrial crosses, bred specifically for intensive poultry breeding (regulated microclimate, balanced feeding and targeted veterinary protection), are well-adapted to climatic conditions, not demanding in terms of keeping and feeding, and resistant to diseases [6]. However, genetic variety of local poultry breeds may be used in the schemes of crossing with the purpose of obtaining hybrids, which would demonstrate high productivity of eggs and meat in conditions of farms and household farms.

Based on these prerequisites, the State Poultry Research Station of NAAS used the national gene fund of poultry (roosters of the industrial line G2, meat-egg White Plymouth Rock breed and hens of line 14, egg-meat Poltava Clay breed) to create a universal hybrid, which allows obtaining meat and egg products of high quality in conditions of poultry-run. Our previous publications demonstrated the universal nature of using the hybrid and presented the economic efficiency of breeding roosters for meat, their fine meat qualities and high quality of eggs.

The aim of the current work is to study the indices of egg productivity of this hybrid and the efficiency of using it in production of food eggs compared to the initial forms.

MATERIALS AND METHODS

The study was conducted at the experimental farm "Preservation of State Gene Fund of Poultry" of the State Poultry Research Station, NAAS of Ukraine. The material of the study was purebred chickens of two initial forms (G2 and 14) and hybrid chickens, obtained via inter-crossing (G2×14). Three groups were formed at the age of 17 weeks to test the hens in terms of egg production: one experimental group (hybrid combination) and two control groups (paternal and maternal forms). The chickens were fed with full ratio combined feeds. The parameters of microclimate, line of feeds and water, light regime, density of sitting birds of all the groups met the relevant requirements.

All the birds were individually weighed at the beginning and at the end of the experiment (on weeks 17 and 49 of their life). The weight of eggs was estimated by weighing the daily collection of eggs at the age of 30 and 49 weeks. During the whole test, the number of laid eggs, the death of birds and feeding expenses were estimated daily for each group, which allowed evaluating the egg production, its intensity and livability of birds in periods (for 40 and 51 weeks of life) as well as feeding expenses per one capita.

At the end of experiment, the economic efficiency of using hybrid layers compared to the basic variants (initial forms) [7] was determined along with the European profit ratio IOFC (Income Over Feed Cost) based on the difference between the income from poultry and expenses to feed it [8], with the indices of estimation being the price of eggs – UAH 2 per one egg, feeds –

Table 1. Economic efficiency features of hybrid and line poultry

Productivity indices	Poultry group			Heterosis, %*
	Paternal form (G2)	Maternal form (14)	Hybrid (G2×14)	
Stock, capita	133	144	85	–
Live weight (kg), aged:				
17 weeks	2.29 ± 0.028	1.70 ± 0.037	2.28 ± 0.029	+14.3
49 weeks	3.54 ± 0.079	2.22 ± 0.093	2.85 ± 0.077	–
Age of laying 1 egg, days	159.8 ± 0.72	145.6 ± 1.13	143.9±1.59 [a1]	–5.8 (–1.2)
Age of 50 % egg production, days	173.7 ± 1.14	163.4 ± 1.45	158.5±1.24 [a1, b2]	–5.9 (–2.9)
Peak of egg production intensity, %	79.0 ± 2.44	79.2 ± 2.15	86.9±1.74[c1, c2]	+9.9 (+9.7)
Tempo of egg production increase, % per week	15.5 ± 1.12	15.7 ± 1.14	19.7±1.47[c1]	+23.5 (+20.1)
Egg weight (g), aged:				
30 weeks	58.8 ± 0.42	54.2 ± 0.47	58.3±0.48 [a2]	+3.0
49 weeks	66.8 ± 0.57	60.9 ± 0.56	68.3±0.71 [a2]	+7.0 (+2.3)
Egg production per an average layer, it.:				
for 40 weeks of life	74.3 ± 2.44	85.2 ± 2.27	91.1±2.77 [b1]	+14.2 (+6.9)
for 51 weeks of life	116.3 ± 3.98	127.5 ± 3.68	136.7±4.38 [b1]	+12.1 (+7.2)
Average egg production intensity, %	51.9 ± 1.79	57.1 ± 1.65	61.7±1.97 [b1]	+13.2 (+8.1)
Poultry livability, %	92.5	94.4	92.9	–

Note. * The effect of zootechnical heterosis (the effect of true heterosis is in brackets). a1, b1, c1 – reliable when a hybrid and a paternal form are compared: a1 – $P > 0.999$, b1 – $P > 0.99$, c1 – $P > 0.95$; a2, c2 – reliable when a hybrid and a maternal form are compared: a2 – $P > 0.999$, c2 – $P > 0.95$.

UAH 6.5 per one kg, live weight – UAH 35 per one kg. It was deemed in calculations that the share of feeds in total expenses was 70 %.

RESULTS AND DISCUSSION

The results of estimates of hybrid and purebred poultry for a number of economic efficiency features, including the indices of egg and meat productivity in different age periods (live weight, early maturity, egg weight, egg production, livability), allowed establishing genetic variety in terms of the abovementioned features and calculating the effect of zootechnical (true, in some cases) heterosis of hybrids (Table 1).

Our studies demonstrated that at the age of 17 weeks, the live weight of hybrid chickens was almost at the level of the paternal form, amounting to 2.28 kg, which is 0.58 kg exceeding the maternal form, the effect of zootechnical heterosis being +14.3 %. Here the hybrids were found to be mature earlier, laid the first egg at the age of 143.9 days – 1.7 days sooner than the maternal form chickens and 16 days earlier than the paternal form. The same tendency was noted for the age of reaching 50 % egg production intensity. In terms of these indices, the hybrids are noted for the effect of true heterosis at the level of 1.2–2.9 %.

The tempo of increasing the intensity and the value of egg production peak were studied among the egg production components. The analysis of the data in Table 1 demonstrates that the value of the peak of egg production intensity for hybrids was 86.9 %, which was 7.7–7.9 % higher than that for initial forms ($P > 0.95$). Here the hybrid poultry demonstrated more intensive increase in egg production from the beginning of egg production to reaching its peak. The tempo of egg production increase for a hybrid was 19.7 % per week, whereas it was 4.2 % less for a paternal form ($P > 0.95$) and 4 % less – for a maternal form. These indices ensured earlier age of reaching the peak, as stated above, as well as the increase in average intensity of egg production for 32 weeks of the productive period. The average egg production intensity since the beginning of laying eggs till the end of the experiment was 4.6–9.8 % higher for hybrid poultry compared to paternal forms, the manifestation of true heterosis at the level of +8.1 % was also established for this feature.

In terms of egg weight, at the age of 30 weeks, hybrid layers exceeded the corresponding index for maternal form considerably (by 4.1 g) and were somewhat lower than the paternal form – by 0.7 g. At this age, the effect of zootechnical heterosis in terms of egg weight was +3.0 %. At the age of 49 weeks, hybrids prevailed over both initial forms in terms of this index – 1.5 g higher than the paternal form, and 7.4 g – than the maternal one, the effect of true heterosis being +2.3 %.

The egg production of hybrid poultry was 91 eggs per average layer for 40 weeks of life and 137 eggs – for 51 weeks, which is 6.5–6.7 % higher than the maternal form and 14.9–18.4 % higher than the paternal

Table 2. The indices of economic efficiency of using hybrid poultry for egg production

Indices	Poultry group		
	Paternal form (G2)	Maternal form (14)	Hybrid (G2×14)
Initial stock, capita	1000	1000	1000
Livability, %	92.5	94.4	92.9
Egg production per an average layer, it.:	116.3	127.5	136.7
Average weight of eggs for the period, g	62.8	57.6	63.3
Body weight at the end of productive period, kg	3.54	2.22	2.85
Expenses for combined feed, kg:			
per 1 capita	32.8	27.0	28.9
per 10 eggs	2.8	2.1	2.1
Cost price of 1 egg, UAH	2.62	1.97	1.96
Profitability, %	2.3	18.8	29.8
Income coefficient IOFC, UAH:			
only for laid eggs	5.9	44.8	71.7
including sale of meat	112.1	111.4	157.2
Economic efficiency, UAH	86.5	0.4	–

one. In terms of this index, the hybrids were noted for the effect of true heterosis at the level of +6.9–7.2 %. The livability of hybrid chickens per year of life was at least 92.9 %.

The estimation of efficiency in using hybrid layers compared to the initial forms as per 1,000 capita is presented in Table 2.

The estimation of economic parameters demonstrated lower cost price of 1 egg while using them from production of hybrid poultry, especially compared to the paternal form – UAH 1.96 against UAH 2.62. This advantage in the cost price was obtained due to higher egg production for a hybrid (by 14.9 %) and lower expenses for feeds (by 13.5 %). When compared to the maternal form, the difference by this index was insignificant, as a higher number of eggs, obtained from hybrid poultry (by 6.7 %), was compensated with higher expenses for feeds per one capita (by 6.6 %). This is also confirmed by the fact that the expenses for feeds per 10 eggs for the maternal form and the hybrid were the same (2.1 kg) whereas this index was much higher for the paternal form – 2.8 kg. Taking into consideration such expenses for feeds, which constituted almost 70 % from the total expenses for poultry breeding, as well as the income from the sale of obtained products (eggs and meat), the profitability of keeping adult hybrid chickens for egg and meat production is 10 % higher compared to maternal form chickens and 27.5 % higher – compared to the paternal line.

The European profit ratio IOFC (Income Over Feed Cost), reflecting the difference between the income from one layer and the cost of feeds, consumed by it, was also estimated for comparative evaluation of the efficiency of using the purebred and hybrid poultry. It is possible that this index is quite acceptable for comparison of poultry groups, as other expenses for poultry breeding were the same for all the groups. On the contrary, it demonstrates the ratio between the productivity of poultry and feed consumption, i.e. the true power of the genetic resource. Therefore, the use of poultry of paternal form for the sole purpose of obtaining food eggs was not really profitable (UAH 5.9/capita) which is explained by low productivity and high feeding expenses for this poultry and is in good agreement with our previous conclusions. At the same, the highest egg production of the hybrid and the average weight of eggs during the experiment (63.3 g) from the hybrid layer allowed obtaining the highest profit (UAH 71.7) which is 1.6 times higher than the same index for the maternal form and 12.1 times – that of the paternal one.

The inclusion of the income for sale of live weight poultry while estimating IOFC ratio allowed increasing the income per one layer in all the group considerably, and here it was the highest for the hybrid again – UAH 157.2 per capita, while almost the same for the initial forms – UAH 111.4–112.1 per capita. Thus, the economic efficiency of egg production of hybrid poultry, the estimation of which includes the index of the cost price, was insignificant compared to the maternal form, amounting to UAH 0.4 per capita, and UAH 86.5 per capita – compared to the paternal form.

CONCLUSIONS

1. The inter-breeding of roosters of meat-egg White Plymouth Rock breed with hens of local egg-meat Poltava Clay breed allowed obtaining a new hybrid combination of chickens with attractive feather color, expressed double productivity and high livability, good adaptation to Ukrainian climatic conditions, and keeping in farms and household farms. 2. The estimation of efficiency of keeping adult birds of a new hybrid combination demonstrated the phenomenon of heterosis in terms of most studied indices: early maturity – at the level of 5.7 % (2–16 days), egg weight – 3–7 % (4.1–7.4 g), egg production – 12–14 % (9.2–20.4 eggs), average weekly intensity – 13 % (4.6–9.8 %). 3. Due to higher egg production of hybrid chicken (136.7 eggs per an average layer against 116.3–127.5 eggs for initial forms) and lower feeding expenses per 10 eggs (2.1 kg against 2.8 kg for a paternal form) as well as live weight at the end of the period of 2.85 kg, the profitability of their egg production was maximal – 29.8 %. 4. While using the hybrid, the European profit ratio IOFC was the highest – UAH 157.2 per capita, which is 28.7–29.1 % higher than the initial forms. The economic efficiency of egg production of hybrid poultry, compared to the maternal form, was UAH 0.4 per capita, compared to UAH 86.5 per capita for the paternal form.

Ефективність використання нового вітчизняного м'ясо-яєчного гібрида для виробництва харчових яєць в присадибних господарствах

С.М. Панькова, О.О. Катеринич

e-mail: svet_my@ukr.net

Державна дослідна станція птахівництва НААН,
с. Бірки, Зміївський р-н, Харківська обл., Україна, 63421

Мета. Детальний аналіз яєчної продуктивності та економічної ефективності використання нового гібрида подвійного призначення в порівняльному аспекті з ви-

хідними формами. **Методи**. Використовували загальноприйняті зоотехнічні методи оцінки живої маси, несучості і її інтенсивності, маси яєць, витрат корму та збереженості дорослих гібридних і чистопородних курей. Розраховували ефекти гетерозису за основними господарсько-корисними ознаками та європейський коефіцієнт прибутку IOFC (Income Over Feed Cost), який відображає різницю між виручкою від однієї несучки і вартістю спожитого нею корму. **Результати**. Практично за всіма вивченими показниками встановлено перевагу гібрида над вихідними формами. За більшістю показників спостерігали явище гетерозису: за скоростиглістю на рівні 5,7 %, за масою яєць 3–7 %, за несучістю 12–14 %. Більш раннє досягнення статевої зрілості (на 2–16 днів), більш інтенсивне нарощування несучості (на 3,3–4,2%), підвищення її середньої інтенсивності на 4,6–9,8 % дозволили отримати від гібридних несучок за рік життя на 9–20 яєць більше, ніж у вихідних форм. Завдяки високій продуктивності та нижчим витратам корму на 10 яєць (2,1 кг проти 2,8 кг у батьківської форми) коефіцієнт прибутку IOFC у гібрида також був на 28,7–29,1 % вищим за вихідні форми. **Висновки**. Отримані зоотехнічні та економічні показники свідчать про доцільність використання несучок нового гібридного поєднання для виробництва харчових яєць у фермерських та присадибних господарствах.

Ключові слова: птиця подвійного призначення, гібрид, яєчна продуктивність, економічна ефективність, вихідні форми.

Эффективность использования нового отечественного мясояичного гибрида для производства пищевых яиц в приусадебных хозяйствах

С.Н. Панькова, О.А. Катеринич

e-mail: svet_my@ukr.net

Государственная опытная станция птицеводства НААН, с. Борки, Змиевской р-н, Харьковская обл., Украина, 63421

Цель. Детальный анализ яичной продуктивности и экономической эффективности использования нового гибрида двойного назначения в сравнительном аспекте с исходными формами. **Методы.** Использовали общепринятые зоотехнические методы оценки живой массы, яйценоскости и ее интенсивности, массы яиц, затрат корма и сохранности взрослых гибридных и чистопородных кур. Рассчитывали эффекты гетерозиса по основным хозяйственно-полезным признакам и европейский коэффициент прибыли IOFC (Income Over Feed Cost), который отображает разницу между выручкой от одной несушки и стоимостью потребленного ею корма. **Результаты**. Практически по всем изученным показателям установлено преимущество гибрида над исходными формами. По большинству показателей наблюдали явление гетерозиса: по скороспелости на уровне 5,7 %, по массе яиц 3–7 %, по яйценоскости 12–14 %. Более раннее достижение половой зрелости (на 2–16 дней), более интенсивное наращивание яйценоскости (на 3,3–4,2 %), повышение ее средней интенсивности на 4,6–9,8 % позволили получить от гибридных несушек за год жизни на 9–20 яиц больше, чем у исходных форм. Благодаря высокой продуктивности и меньшим затратам корма на 10 яиц (2,1 кг против 2,8 кг у отцовской формы) коэффициент прибыли IOFC у гибрида также был на 28,7–29,1 % выше от исходных форм. **Выводы**. Полученные зоотехнические и экономические показатели свидетельствуют о целесообразности использования несушек нового гибридного сочетания для производства пищевых яиц в фермерских и приусадебных хозяйствах.

Ключевые слова: птица двойного назначения, гибрид, яичная продуктивность, экономическая эффективность, исходные формы.

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