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The effect of age and sex of broiler chickens on slaughter value, feed conversion and production costs

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ABSTRACT

188 male and 188 female one-day-old ISA Vedette broiler chicks were fed *ad libitum* with standard broiler diets, DKA-starter (to the age of 3 weeks), DKA-grower (from 4 to 6 weeks) and DKA-finisher (from 7 to 12 weeks). From week 3 on, 10 cockerels and 10 hens were slaughtered at weekly intervals and the carcasses were dissected.

The optimum fattening period for ISA Vedette broiler chickens ranges between 6 and 8 weeks. When the fattening period was extended towards the upper limit, the following positive effects were observed: increased dressing percentage, lower costs of purchasing chicks per unit of product and higher European Production Index. On the other hand, some drawbacks occurred, such as decreased feed conversion, higher costs of feed and higher fat content in the carcass. The unfavourable effects were more intense in females than males as the birds grew older. Consequently, the fattening period should be longer for cockerels and shorter for hens.

KEY WORDS: broiler chickens, slaughter value, feed conversion, production costs

INTRODUCTION

Research conducted on Pekin ducks (Leeson and Summers, 1982; Lewczuk et al., 1985), Muscovy ducks (Romboli and Avanzi, 1980), geese (Bochno et al., 1989; Janiszewska, 1993), turkeys (Salmon et al., 1982; Bochno et al., 1993), laying-type hens (Janiszewska et al., 1996) and broiler chickens (Leeson and Summers, 1980) reveals that the slaughter value of birds changes depending on their age. Likewise, feed

consumption and production costs alter (Bochno et al., 1993; Janiszewska, 1993; Kaliszewicz et al., 1988; Leeson and Summers, 1980, 1982; Lewczuk et al., 1985, 1988). Therefore, when the duration of a fattening period is determined for a particular commercial variety within a breed, the following factors should be considered: body weight, feed conversion ratio, slaughter value of birds and production costs.

The aim of the study was to determine selected indices of slaughter value, feed conversion ratio and partial production costs for different fattening periods of broiler chickens.

MATERIAL AND METHODS

One-day-old, sexed, ISA Vedette broiler chicks (188 ♂ and 188 ♀) were used in the experiment. After weighing and marking with wing markers, chickens were placed in 8 pens of 3.5 x 2m (47 chicks of the same sex per pen). Light and temperature were kept according to standard recommendations.

The birds were fattened to the age of 12 weeks. They were fed *ad libitum* with standard broiler diets: DKA-starter (to week 3), DKA-grower (from week 4 to 6) and DKA-finisher (from week 7 to the end of the fattening period), containing, respectively, 12.70, 13.31 and 12.65 MJ metabolizable energy and 19.6, 19.1 and 18.3 g of crude protein per kg of feed.

Starting from day 1 of life the birds were weighed and, from week 3, ten males and ten females were randomly chosen, fasted for approximately 10 h and slaughtered by silting the jugular vein at the cranial basis. After bleeding, the birds were scalded for about 1 min at 63°C, plucked by hand and eviscerated. Afterwards, the head, shanks and wing ends were removed. Carcasses were cooled, cut into parts (the breast, thigh+drumstick, neck, wings and back), and dissected to separate meat, skin with subcutaneous and intermuscular fat, and bones.

In calculating costs of purchasing chickens and feeds, the prices of January 1996 (the start of the experiment) were used: a chick – 1.00 zł, DKA-starter – 0.95 zł/kg, DKA– grower – 0.94 zł/kg, and DKA-finisher – 0.92 zł/kg.

The data on individual body weight and after-slaughter traits were analyzed statistically. Means (x) and standard errors of the mean (SEM) were calculated and the significance of differences:

- between means for age and sex groups by the two-factorial analysis of variance (F test and Duncan's multiple test),
- between means of sexes in each age group by Student-t test, were determined.

In the analysis of variance for traits connected with feed utilization, all birds were examined in groups (with 4 replications in each sub-group). The European Production Index (EPI) was calculated using the formula according to Gawęcki (1996):

$$EPI = \frac{\text{Body weight (kg) x survival rate (\%)}}{\text{age (days) x feed consumption (kg) per 1 kg of body weight}} \times 100$$

$$\text{and the dressing percentage (DP)} = \frac{\text{carcass weight + giblets weight}}{\text{body weight before slaughter}} \times 100$$

RESULTS

During the whole fattening period 22 male (11.79%) and 9 female (4.79%) chickens either died or were removed due to poor health; to week 6 the values were 14 (7.45%) and 7 (4.79%), respectively.

The average body weight of one-day-old cockerels and hens was 37 g. During the fattening period the body weight of males rose to 2199 g at week 6 and 5273 g at week 12; the values for females were 1930 and 4216 g, respectively. Differences in the body weight between age groups as well as between male and female chickens from week 6 were statistically significant (Tables 1 and 2).

Dressing percentage went up from 70.5% of male and female birds slaughtered at the age of 3 weeks to 76.8% of males at 9 weeks and 76.4% of females at 8 weeks, afterwards it remained nearly unchanged to the end of the fattening period (Figure 1).

Meat content in carcasses of birds slaughtered at the age of 3 weeks averaged 242 g for both sexes, and it rose up to 2081 g at 12 weeks of age (Table 1). The content of skin together with subcutaneous and intermuscular fat also increased (from 69 to 707 g). The relation between the content of the carcass tissue components and the sex resembled the tendency observed for body weight; it was more evident for male than for female birds. The difference in the meat content between the sexes was confirmed statistically in the age groups from week 7 to 12 of the fattening period (Table 2).

The percentage of carcass tissue components showed a slightly different tendency; the contents of meat and fat with skin to week 8 were similar in male and female carcasses, with the content of fat with skin increasing somewhat faster than the content of meat. From week 7 to 12 female carcasses had a higher content of fat and a lower content of meat compared to male carcasses (Figure 2). The percentage of breast muscles in the carcass grew with age; equaling 19% at week 3 and 22.8% at week 12 for male carcasses and 23.4% for female carcasses (Tables 1 and 2). The breast percentage in the carcass showed a similar increase (from 31 to 34.1% for males and 35.9% for females). The percentage of legs (thigh + drumstick) remained unchanged in male carcasses (approximately 30.5%) and declined in female carcasses (from 30.5 to 29.1%) as the birds grew older (Figure 3).

TABLE 1

Means (x) for body weight and some after-slaughter traits, standard errors of mean (SEM)

Specification	Statistics	Age, weeks													Sex		Significance of interaction
		0	1	2	3	4	5	6	7	8	9	10	11	12	♂	♀	
		A	ABa	Bb	C	D	E	F	G	H	I	J	J	K			
Body weight, g	$\bar{x}$	37	116	338	645	1070	1563	2065	2637	3287	3655	4187	4332	4744	2406**	2006	**
	SEM	0.63	4.40	5.10	13.27	26.48	38.11	59.15	77.32	97.46	127.53	144.04	149.54	172.09	163.97	129.68	
Content in carcass of, g					A	B	C	D	E	F	G	Ha	Hb	I			
meat	$\bar{x}$				242	407	624	833	1093	1401	1584	1819	1944	2081	1025**	848	**
	SEM				5.85	11.23	20.45	28.09	31.66	40.48	58.18	78.72	65.42	88.48	73.94	57.80	
					ABa	Bb	C	D	E	Fc	Fd	G	G	H			
skin with fat	$\bar{x}$				69	121	181	270	364	479	565	627	655	707	324**	294	
	SEM				2.19	7.80	7.20	14.91	20.12	22.83	37.27	29.18	45.78	37.82	23.77	21.83	
Percentage of breast muscles					ABa	BCb	Cbc	Cbc	Cbc	CDc	DEd	E	E	E			
in carcass	$\bar{x}$				19.13	19.64	20.79	20.96	21.03	21.60	21.78	22.85	23.69	23.09	20.57	21.50**	**
	SEM				0.29	0.25	0.30	0.38	0.26	0.47	0.31	0.33	0.50	0.36	0.21	0.24	

means marked with letters (age) or * (sex) are significantly different; capital letters or ** – significance P = 0.01, small letters or * – significance P = 0.05

TABLE 2

Means (x) for traits with significant age x sex interaction in sub-groups

Specification	Sex	Age, weeks												
		0	1	2	3	4	5	6	7	8	9	10	11	12
Body weight, g	♂	37	117	341	662	1113	1646	2199*	2837*	3613**	3978*	4678**	4781*	5273*
	♀	37	115	334	628	1027	1479	1930	2437	2961	3333	3697	3883	4216
Meat content in carcass, g	♂				250	415	661	889	1178*	1513*	1737*	2075**	2125*	2336*
	♀				234	398	586	777	1008	1289	1430	1564	1703	1827
Percentage of breast muscles in carcass	♂				19.18	19.42	20.79	20.73	20.31	20.24	21.59	22.34	22.19	22.81
	♀				19.09	19.85	20.79	21.18	21.74	22.97**	21.98	23.36	25.18**	23.37

means (for sexes) marked with ** or * differ at P = 0.01 and P = 0.05, respectively

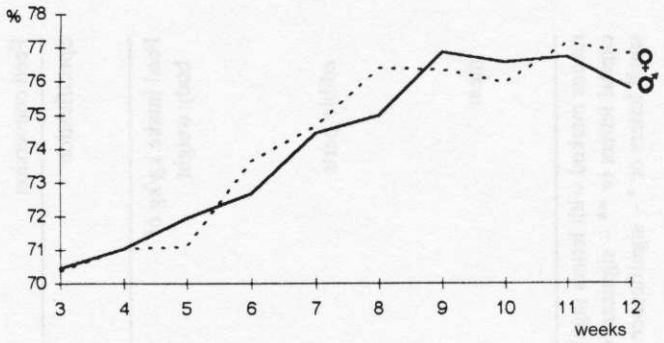

Figure 1. Dressing percentage, %

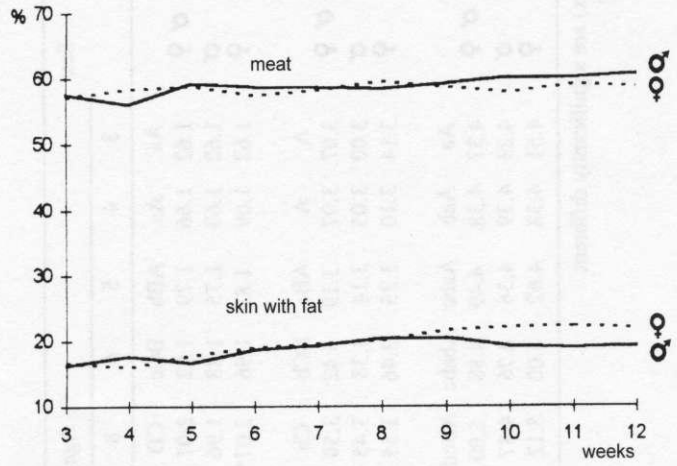

Figure 2. Percentage of meat and skin with fat in carcass

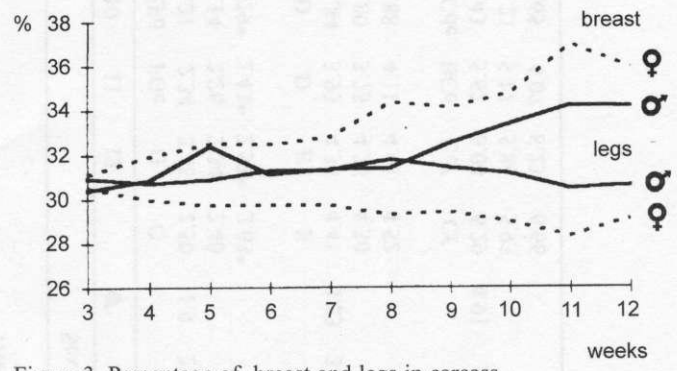

Figure 3. Percentage of breast and legs in carcass

TABLE 3

Feed conversion

Specification	Sex	Age, weeks										Sex	
		3	4	5	6	8	9	10	11	12		♂	♀
Feed intake kg/kg of		Aa	Aa	ABb	BCc	CD	DE	EFd	FGe	G	G		
body weight	♂ ♀	1.62	1.66	1.79	1.92	2.01	2.11	2.21	2.34	2.43	2.50	1.9	2.00**
	♂	1.62	1.63	1.75	1.88	1.96	2.04	2.14	2.26	2.34	2.40		
	♀	1.62	1.69	1.83	1.96	2.07*	2.19*	2.29*	2.43*	2.53*	2.63*		
		A	A	ABa	BCb	Cb	Cb	D	D	E	E		
edible parts	♂ ♀	3.07	3.07	3.19	3.42	3.50	3.52	3.84	3.93	4.33	4.41	3.23	3.33*
	♂	3.00	3.05	3.14	3.38	3.45	3.47	3.80	3.75	4.25	4.30		
	♀	3.14	3.10	3.25	3.46	3.55	3.58	3.88	4.11	4.41	4.52		
		Aa	Aab	Aabc	Ababc	ABcd	Abcd	BCde	BCe	Cef	Cf		
meat	♂ ♀	4.37	4.38	4.49	4.88	5.00	5.01	5.43	5.62	6.04	6.29	4.91	5.18
	♂	4.23	4.39	4.36	4.76	4.87	4.91	5.21	5.17	5.86	5.93		
	♀	4.51	4.38	4.62	5.00	5.12	5.24	5.65	6.07	6.23	6.66		

means marked with letters (age) or * (sex) are significantly different
capital letters or ** – signicance P = 0.01
small letters or * – significance P = 0.05

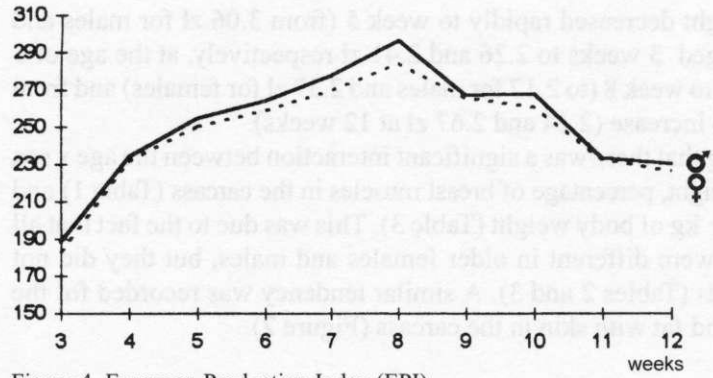

Figure 4. European Production Index (EPI)

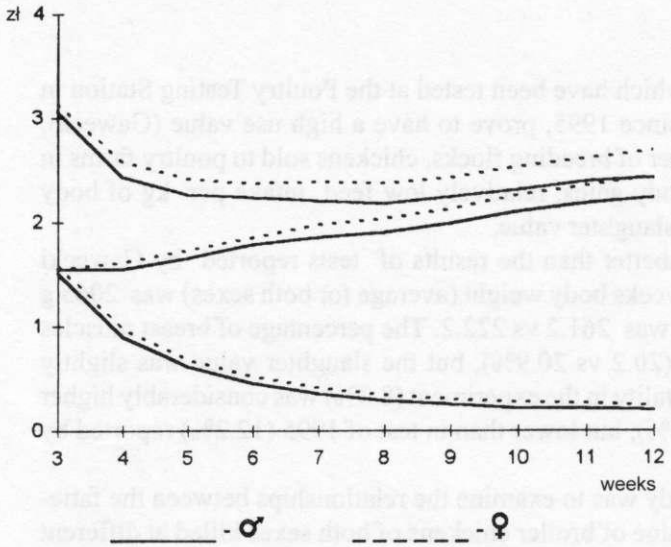

Figure 5. Cost of chicks (1), feed (2) and total cost of chicks and feed (3) per 1 kg of body weight

At the age of 3 weeks, feed consumption per kg of body weight was on average 1.62 kg for both males and females, but rose to 2.5 kg at 12 weeks (Table 3). A similar rising tendency was revealed for feed consumption per kg of edible parts (the carcass and giblets without bones) and meat.

Taking into consideration the relationship between feed consumption and sex, it was observed that hens used more feed per 1 kg of body weight than cockerels. Likewise, they needed more feed to produce 1 kg of edible parts or meat.

The European Production Index (EPI) was best for the fattening period of 8 weeks (296.1 for cockerels and 283.6 for hens; Figure 4).

The cost of purchasing chicks per 1 kg of body weight declined with the age of the bird whereas the cost of feed rose (Figure 5). The total cost of chicks and feed

per unit of body weight decreased rapidly to week 5 (from 3.06 zł for males and 3.14 zł for females aged 3 weeks to 2.26 and 2.41 zł respectively, at the age of 5 weeks), more slowly to week 8 (to 2.17 for males and 2.37 zł for females) and from week 9 on it began to increase (2.14 and 2.67 zł at 12 weeks).

It is worth noticing that there was a significant interaction between the age x sex body weight, meat weight, percentage of breast muscles in the carcass (Table 1) and feed consumption per kg of body weight (Table 3). This was due to the fact that all these characteristics were different in older females and males, but they did not differ in younger birds (Tables 2 and 3). A similar tendency was recorded for the percentage of meat and fat with skin in the carcass (Figure 2).

DISCUSSION

ISA Vedette chickens, which have been tested at the Poultry Testing Station in Wroniawy near Wolsztyn since 1995, prove to have a high use value (Gawęcki, 1996). Produced by a number of breeding flocks, chickens sold to poultry farms in Poland have satisfactory body gains, relatively low feed intake per kg of body weight, high EPI and good slaughter value.

Our results are slightly better than the results of tests reported by Gawęcki (1996), e.g. at the age of 6 weeks body weight (average for both sexes) was 2065 g vs 1928 g; the value of EPI was 261.2 vs 222.2. The percentage of breast muscles in the carcass was similar (20.2 vs 20.9%), but the slaughter value was slightly lower (73.1 vs 74.8%). Mortality in the experiment (8.3%) was considerably higher than in the test of 1996 (2.6%), but lower than in test of 1995 (12.2%) reported by Gawęcki (1996).

The main aim of the study was to examine the relationships between the fattening result and slaughter value of broiler chickens of both sexes killed at different ages. A relatively long period of fattening was therefore planned, during which feed consumption and slaughter value were determined as well as the costs of chicks and feed per unit of production, which can amount to 78% of total costs (Świerczewska et al., 1995).

ISA Vedette chickens are late to mature somatically. At weekly intervals their body weight grew significantly from the beginning to the end of the fattening period (12 weeks). Also, the content of meat and fat with skin in the carcass increased significantly (Table 1). The content of fat with skin grew faster than the content of meat (Figure 2); the same observation was made for other commercial broiler chickens (Leeson and Summers,1980).

Sex significantly affects body weight and slaughter value of broilers (Leeson, 1980; Thomas, 1983) and other domestic birds, turkeys (Salmon et al., 1982; Bochno et al., 1993), Pekin ducks (Leeson et al., 1982; Lewczuk et al., 1985), Muscovy

ducks (Romboli and Avanzi, 1980) and geese (Bochno et al., 1989; Janiszewska, 1993). For broiler chickens, sexual dimorphism in body weight is revealed at day 10 of life. In the present study it was as late as the 6th week of life that the body weight of males significantly exceeded that of females. A week later a considerable difference in the meat content of the carcass was also noticed (Table 2). The difference in the meat to fat with skin ratio in the carcass was observed from week 9. In female carcasses the content of fat with skin was higher than the meat content, in contrast with males, which contained more meat than fat (Figure 2). Moreover, female carcasses had a higher percentage of the breast part and lower of legs compared with males (Figure 3).

From week 3 to 5 of the fattening period, feed intake per kg of body weight and edible parts or meat slightly increased. From 6 week on, a considerable increase in feed intake per unit of body weight was noticed; males using more feed than females (Table 3). In the same period, the fat content in female carcasses was growing faster than in males (Figure 2). Consequently, a higher feed intake per unit of body weight by older birds as well as by females compared with males can be attributed, in part, to a more intense fat deposition by older birds compared with younger ones, and by females compared with males. The fact that the bird uses 4-fold more feed to produce one unit of fat than meat adds to the production costs, as the cost of feed accounts for approximately 73% of the total production costs of broilers (Świerczewska et al., 1995).

The results obtained in this study indicate that the optimum fattening period of ISA Vedette broiler chickens is between 6 and 8 weeks. As it is approaching the upper limit, the following effects can be expected: advantages – higher slaughter value and percentage of the breast, lower cost of buying chicks per unit of final product and higher EPI; disadvantages – higher feed consumption and its cost as well as an increased fat content in the carcass. The unfavourable effects become more pronounced for older birds and for females. It is recommendable, then, to plan different fattening periods: longer for cockerels and shorter for hens.

When the fattening period exceeds 8 weeks, the negative processes, such as an increase in feed intake per unit of product, higher production costs, lower EPI, as well as a higher fat content and lower meat content are more evident in female carcasses compared with males.

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STRESZCZENIE

Wpływ wieku i płci kurcząt brojlerów na ich wartość rzeźną, wykorzystanie paszy i koszty produkcji

188 kogutków i 188 kurek, seksowanych 1-dniowych piskląt ISA Vedette, żywiono do woli standardowymi mieszankami DKA-starter (do wieku 3 tygodni), DKA-grower (od 4 do 6 tygodni) i DKA-finiszer (od 7 tygodnia). Tucz prowadzono do wieku 12 tygodni. Poczynając od trzeciego tygodnia życia w odstępach 7-dniowych ubijano po 10 kogutów i 10 kurek, a ich tuszki poddawano dysekcji.

Stwierdzono, że optymalny okres tuczu kurcząt brojlerów ISA Vedette waha się w stosunkowo szerokich granicach, od 6 do 8 tygodni. Przy dłuższym okresie tuczu należy oczekiwać zwiększenia wydajności rzeźnej i zmniejszenia udziału kosztów zakupu piskląt przypadających na jednostkę uzyskiwanego surowca oraz wzrostu wartości Europejskiego Wskaźnika Wydajności (cechy dodatnie), a także pogorszenia wykorzystania paszy i zwiększenia jej kosztu oraz zwiększenia niepożądanego otłuszczenia tuszki (cechy ujemne). Wraz z wiekiem ujemne procesy nasilają się bardziej u kurek niż u kogutków, co przemawia za celowością różnicowania długości okresu odchowu – dłuższego dla kogutków, a krótszego dla kurek.