Studies on the Energy Content of Pigeon Feeds II. Determination of the Incorporated Energy

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ABSTRACT The effect of breed and sex on adult body composition of four pigeon breeds: Texan (TEX), Mondain (MON), Szeged Tumbler (SZT), and homing (HOM) and on the digestibility coefficients (DC) and metabolizable energy (ME) content of their feeds was studied. A total of eight groups, each comprising five males and five females of each breed, were used. All birds were fed the same pelleted pigeon feed (17.27% CP) *ad libitum*. After the metabolic study, the whole body was analyzed for dry matter (DM), ash, CP, and ether extract (EE) contents. The DC of DM, TEX, MON, and HOM pigeons did not differ significantly, whereas DC for the SZT breed were consistently lower. In the majority of cases, the DC values obtained for males were higher, irrespective of the breed. The body composition of the two sexes was first compared within a given breed, and no major differences were detected. Interbreed differences were greater. The DM content of the body of HOM pigeons exceeded that of the other three breeds for both sexes. For ash and CP content of the body, the reverse was found, i.e., the values of both parameters were lower in HOM pigeons. The HOM pigeons had significantly ($P < 0.05$) higher body fat (EE) content as compared with the other three breeds except TEX females. The NFE value for HOM also tend to be higher than in the other three breeds.

(*Key words*: pigeon, breeds, sex, digestibility, body composition)

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INTRODUCTION

The purpose of pigeon breeding is basically threefold: the production of sports pigeons, ornamental pigeons, and utility (meat-type) pigeons. Tumblers (waltzing), pigeons belonging to the sports pigeon category, mostly derive their name from that of countries, areas, or towns where they have been bred. Breeds suitable for flying sports differ from each other, not only in their body composition but also in their flying properties. For example, the Szeged Tumblers (SZT) glide like butterflies. In the strict sense of the word, the homing (carrier) pigeon (HOM) also belongs to the group of sports pigeons; however, its breeders have an independent organization in several countries.

Numerous breeds are used for breeding utility pigeons. However, no data are available as to whether these breeds differ in body composition, efficiency of digestion, and retention of nutrients. Results of experiments on broiler chickens (Mahapatra *et al.*, 1984; Chambers, 1990; Ristic, 1991; Brake *et al.*, 1993; Xiong *et al.*, 1993) indicate that the protein, fat, water, and ash content of the birds' body is influenced by breed, age, sex, and nutrition. According to Böttcher *et al.* (1985), the feeding of higher levels of protein is accompanied by a decrease in body fat and water content and an increase in its protein content. Similar data on pigeons can scarcely be found in the literature. The only information available concerns the composition of pigeon meat (Vogel, 1980). However, there are some indirect results regarding the BW, BW gain (Pelzer, 1990a,b), and feed conversion ratio (Rizmayer, 1969) of young meat-type pigeons as a function of the breed.

In the experiment reported in this paper, two utility breeds [Texan (TEX) and Mondain (MON)] and two sports breeds (SZT and HOM) were studied to determine whether there were any breed- or sex-related differences in the body composition of adult birds as well as in the digestibility coefficients (DC) of nutrients and metabolizable energy (ME) content of the same feed.

MATERIALS AND METHODS

Birds and Housing

The trial was carried out in the experimental animal facilities of the Department of Animal Breeding, Nutri-

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Abbreviation Key: HOM = Homing pigeon; CF = crude fiber; EE = ether extract; MON = Mondain; NFE = N-free extract; OM = organic matter; SZT = Szeged Tumbler; TEX = Texan

TABLE 1. Liveweight of pigeons (g) immediately before the analysis of body composition

	TEXAN		SZEGED TUMBLER	
	Female	Male	Female	Male
Mean	514	583	269	311
SD	42	46	19	21
	MONDAIN		HOMING PIGEON	
Mean	735	792	435	459
SD	82	44	42	54

[1]n = 5.

tion and Laboratory Animal Science, University of Veterinary Science, Budapest, Hungary, in the month of October. A total of 40 adult pigeons (10 of each breed, i.e., TEX, MON, SZT, and HOM) were placed into individual metabolic cages suitable for the quantitative measurement of feed intake and the excreta. Eight groups were formed, and each breed was represented by five males and five females. During the trial, the amount of feed consumed was measured daily on an individual basis. Excreta were collected from each bird twice a day and stored at −20 C until laboratory analysis. The 4-d excreta of one bird constituted one sample. The pigeons were cared for according to the Canadian Council on Animal Care guidelines (CCAC, 1993). This study was approved by the Animal Use and Care Administrative Committee of the Hungarian Scientific Chamber and complies with European Union directives regarding the use of experimental animals (CECAE, 1992).

Experimental Procedures

All birds had *ad libitum* access to the same commercial pelleted pigeon diet that had been fed to them earlier. The diet contained 92.10% DM, 17.27% CP, 2.18% ether extract (EE), 5.34% crude fiber (CF), 61.00% N-free extract (NFE), and 2,550 kcal AME_n on average (analyzed values). A room temperature of 15 to 18 C and a relative humidity of 60 to 75% were maintained throughout the experiment. The concentration of CO_2 was below 0.2 vol %, whereas that of NH_3 was below 0.002 vol %.

When the metabolic experiment was finished, the pigeons were deprived of feed for 24 h, weighed (Table 1), and then euthanatized using CO_2 as an inhalation agent. Subsequently, DM, ash, CP, and EE contents of the whole body (including the feathers) were determined. The NFE and GE contents of feed and excreta samples and the pigeon carcasses were calculated using data of the proximate analysis and the equation of Schiemann *et al.* (1971). Separation of the N content of excreta into N of urinary and fecal origin was done by a chemical method (Jakobsen *et al.*, 1960). The proximate chemical analysis of the feed and excreta samples and the whole body were determined according to AOAC (1975).

Calculations and Statistical Analysis

Digestibility and body composition data were analyzed using the general linear model procedure for analysis of variance (SPSS, 1992). Significant differences among means for breed and sex were separated by Duncan's multiple-range test with 5 and 1% levels of probability (Duncan, 1955).

RESULTS AND DISCUSSION

The data from the literature contain rather diverse values as far as the recommended composition of pigeon feeds is concerned. For CP, for example, the allowances are between 12 and 18% (Boidot, 1968; Morice, 1970; Levi, 1972, 1974; Klein, 1974). We used a pelleted feed of 17.27% CP to avoid the possibility of a relative protein deficiency.

Table 1 presents the BW of adult pigeons used in the experiment, divided by breed and sex. The TEX variety reared for meat is usually of medium body size and thus requires less feed for maintenance. The TEX pigeons brought into Hungary have a BW of about 550 g. The current type of MON has a BW of 740 to 800 g; the individuals we examined had a BW falling in that range. Naturally, SZT pigeons have the lowest body weight. From the BW data it can be seen that the HOM pigeon examined by us was of the Exhibition Homer type, rather than of a meat type (Giant Homer).

Table 2 shows the DC of nutrients and the ME content of a given pigeon feed depending on the breed and sex of the pigeons used in the metabolic trial. From the interbreed comparison of DM digestibility (Table 2), it can be seen that the values obtained for SZT pigeons of both sexes were lower than those of the other three breeds. The differences were significant ($P < 0.05$) compared with the TEX. Similar findings were obtained for the CP, i.e., the values found for the SZT breed were lower than those of both sexes of the other three breeds. In females, the difference was significant ($P < 0.05$) as compared with any of the other three breeds. In the digestibility of EE, significant breed-related differences ($P < 0.01$) were demonstrated only between TEX and MON females; the other differences were not conclusive because of the high standard deviations. As for the EE, no significant or even trend-like differences could be detected between the breeds studied in the experimentally determined ME content of the feed.

After comparison of the DC of the DM and CP contents of feeds for the two sexes within the individual breeds studied, no significant differences were detected, but the values obtained for males were consistently higher. With the exception of a single breed (HOM pigeons), the same was found for the experimentally determined ME content of the feed. The DC of EE showed high standard deviations in several groups and thus the above tendency could not be demonstrated clearly. A significant ($P < 0.05$) sex-dependent difference was detectable only between the MON females and males. Thus, sexual dimorphism manifests itself much less in the pigeon breeds studied than in chickens.

Table 3 shows the body composition of pigeons according to breed and sex. Comparison of the data ob-

TABLE 2. Nutrient digestibility (%) and AME_n (kcal/kg) content of pigeon feed according to breed and sex

	Dry matter	Crude protein	Ether extract	AME_n[1]
TEXAN, female				
Mean[2]	65.29[a]	83.87[a]	88.08[c]	2,600
SD	2.01	1.05	0.97	22
TEXAN, male				
Mean[2]	66.52[a]	84.38	88.82	2,659
SD	1.72	1.37	4.96	62
MONDAIN, female				
Mean[2]	64.74	83.91[a]	84.37[ad]	2,602
SD	2.32	1.31	0.95	73
MONDAIN, male				
Mean[2]	65.14	83.70	88.49[b]	2,614
SD	1.65	1.07	1.52	108
SZEGED TUMBLER, female				
Mean[2]	61.60[b]	80.84[b]	87.93	2,469
SD	2.04	1.35	4.18	37
SZEGED TUMBLER, male				
Mean[2]	62.67[b]	82.38	86.02	2,513
SD	2.45	0.66	5.17	90
HOMING PIGEON, female				
Mean[2]	64.20	82.97[a]	86.50	2,614
SD	1.18	0.76	6.18	18
HOMING PIGEON, male				
Mean[2]	65.94	83.35	85.93	2,634
SD	2.30	1.20	2.61	97

[a,b]Difference between data in the same column is significant on the level of $P < 0.05$.
[c,d]Difference between data in the same column is significant on the level of $P < 0.01$.
[1]AME_n = Apparent metabolizable energy corrected to zero nitrogen retention.
[2]n = 5.

tained for the two sexes within a given breed showed no significant difference between males and females in body composition. In this respect, the significant ($P < 0.05$) difference found for the TEX breed in two variables (DM and ash) and that demonstrated in body energy content for the SZT breed do not appear to be convincing. For EE, there were high individual differences within a given breed or sex. Even if we disregard that fact, no clear sex-dependent differences were demonstrated either for the utility or the sports pigeons. The above results indicate that the statement made for broiler chickens (Stadelman *et al.*, 1988), i.e., that there are major sex-dependent differences in body composition, does not hold for pigeons. In that regard, Holcman *et al.* (1995) also found that the meat of cockerel chicks had higher fat content, whereas the carcass of pullets contained more abdominal fat.

The comparison of pigeon breeds shows much more pronounced differences. Interestingly, however, there was no clear distinction between the utility breeds (TEX and MON) and the sports breeds (SZT and HOM). At the same time, the HOM pigeons differed markedly from the other breeds in all variables measured, and these differences were significant in most cases. The carcass DM content of HOM pigeons exceeded that of the other three breeds for both sexes. The differences were significant ($P < 0.05$, $P < 0.01$, $P < 0.001$) in all cases except for the TEX females. Analysis of body ash and CP content showed the reverse; i.e., the values of both variables were lower in HOM pigeons. Most of the differences were also significant ($P < 0.05$, $P < 0.01$, $P < 0.001$) in this case. For HOM pigeons, the most striking finding was that their body fat content is significantly higher ($P < 0.05$, $P < 0.01$, $P < 0.001$) than that of all the other breeds studied, with the exception of TEX females. The concentration of NFE was the highest for the HOM breed, especially in males. The same tendency was supported by the values of body GE content, which were the highest for HOM pigeons. The differences in comparison with the other breeds were significant ($P < 0.05$).

Studying the effect of breed in chickens, Zlender *et al.* (1995) concluded that provenance significantly influenced the water and fat content of poultry meat but exerted a less expressed effect on protein and ash content. They found that average water content of the chicken carcass was 70%, whereas the fat content was 8 to 10%. In chickens, even individual lines differ in this respect. Holcman *et al.* (1995) studied the dressing percentage, abdominal fat content, and chemical composition of the meat in 8-wk-old chickens selected for body weight over 17 generations. For chemical composition of the carcass, larger differences between the lines selected for higher body weight and the nonselected lines were found in fat content. The smallest difference was in water content, whereas protein and ash content did not change significantly. Chickens selected for higher body weight were more fatty at 47 d of age, but their breast and thigh muscles contained less water. It appears that in the pigeon the situation is not as clear. Differences in breed or purpose of utilization do not necessarily

TABLE 3. Body composition of adult pigeons according to breed and sex

	Dry matter	Ash	Crude protein	Ether extract	NFE[1]	Gross energy[2]
	(g/100 g)					kcal/g
TEXAN, female						
Mean[3]	42.41[x]	4.07[y]	23.29	13.40	1.65	2.67
SD	3.40	0.55	1.36	4.69	0.22	0.39
TEXAN, male						
Mean[3]	38.28[e,y]	3.40[e,y]	23.77[a]	9.80[e]	1.32[b]	2.34[f]
SD	2.07	0.10	0.50	1.96	0.37	0.20
MONDAIN, female						
Mean[3]	40.18[e]	3.05	23.17	11.96[c]	1.99	2.54[f]
SD	1.34	0.23	1.46	2.35	0.35	0.16
MONDAIN, male						
Mean[3]	39.95[c]	3.21[a]	22.26[b]	12.47[ac]	2.00	2.54[d]
SD	2.55	0.04	0.67	2.47	0.31	0.23
SZEGED TUMBLER, female						
Mean[3]	38.55[c]	3.68[c]	23.88[c]	9.34[c]	1.65	2.32[d]
SD	2.95	0.33	0.80	3.58	0.27	0.31
SZEGED TUMBLER, male						
Mean[3]	41.47[a]	3.60[a]	25.00[a]	11.37[c]	1.50[b]	2.57[d]
SD	2.77	0.46	1.44	2.15	0.50	0.23
HOMING PIGEON, female						
Mean[3]	45.51[df]	2.91[bd]	22.07[d]	18.46[d]	2.07	3.10[ce]
SD	1.57	0.12	0.68	1.92	0.50	0.16
HOMING PIGEON, male						
Mean[3]	45.34[bd]	2.93[bf]	22.91[b]	17.25[ad]	2.25[a]	3.04[ce]
SD	1.82	0.18	0.55	2.07	0.57	0.17

[a–f]Significant difference at $P < 0.05$ (a, b), $P < 0.01$ (c, d) and $P < 0.001$ (e, f) between the breeds within a given sex, for data within the same column.

[x,y]Significant difference at $P < 0.05$ between the sexes within a given breed, for data within the same column.

[1]NFE = N-free extract.

[2]Calculated after Schiemann *et al.* (1971).

[3]n = 5.

involve changes in body composition; however, the finding that HOM in living habits are similar to the wild pigeon (dove or Columba livia) suggests that during domestication, body fat and NFE may decrease, whereas protein increases.

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