

THE EFFECT OF GENOTYPE, KEEPING TECHNOLOGY AND SEX ON THE TEXTURAL ATTRIBUTES OF CHICKEN MEAT

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SUMMARY

The objective of this study was to characterize the textural attributes of chicken breast meat related to genotypes, breeding technologies and sex. Seven genotypes such as pure bred Yellow Hungarian (YH) chickens, Yellow Hungarian pullets crossed with S 77 (YH x S 77), Foxy Chick (YH x FO), Redbro (YH x RB), Hubbard Flex (YH x HF) and Shaver Farm (YH x SF) meat-type cocks and Ross 308 commercial broiler chickens were examined. Cross-bred hybrids and YH chickens were reared under free range conditions for 84 days and Ross 308 chickens were industrially bred for 42 days.

Texture Profile Analysis (TPA) of the treated samples was performed to determine textural attributes such as hardness, gumminess and chewiness of breast meat samples.

The obtained hardness, gumminess and chewiness values of chickens' breast meat reared in free range conditions were higher compared to those of industrially reared broilers. Although, the acceptance of various meat attributes by consumers are heterogeneous and is not yet well understood.

ÖSSZEFOGLALÁS

Konrád, Sz. – Kovácsné Gaál, K. – Viténger, E.: A GENOTÍPUS, A TARTÁSTECHNOLÓGIA ÉS AZ IVAR HATÁSA A MELLHÚS TEXTURÁLIS TULAJDONSÁGAIRA

A kísérlet célja annak megállapítása, hogy a genotípus, az ivar és alkalmazott tartástechnológia milyen hatást gyakorol a mellhús texturális tulajdonságaira. A kísérletben 84 napig kifutóztottan nevelt fajtatiszta sárga magyar tyúk, annak hústípusú kakasokkal (S 77, foxy chick, redbro, hubbard flex, shaver farm) történő keresztezésével előállított végtermékek és temelőtől vásárolt, 42. napos korig nagyüzemi körülmények között hizlalt Ross 308 hibridek paramétereit hasonlították össze. Stevens QTS 25 műszerrel meghatározták a mellhús keménységi, gumissági és rágóssági értékét. A vizsgálatok során azt tapasztalták, hogy az ivar nem, a genotípus és a tartástechnológia, illetve azok együttes hatása azonban egyértelműen befolyásolta mindhárom vizsgálati paramétert. A mellhús keménysége a 84. napos korig szabadtartásos rendszerben nevelt állományokban 865,5 grammot, míg a 42. napos korig intenzíven hizlalt Ross 308-as brojlerekben, ennél $P < 0,05$ szinten szignifikánsan kisebb értéket, 209,3 grammot mutatott.

Szabadtartásos csirkék esetében gumisságra 353,4 grammot, rágósságra 1154,7 értéket mértek, míg ugyanezek a paraméterekre, a nagyüzemi brojlerek esetében 151,8 grammot illetve 476,7 értéket kaptak; a különbségek mindkét esetben $P < 0,05$ szinten statisztikailag igazolhatóak voltak.

A tapasztalt eltéréseknek a fogyasztók szempontjából történő megítélése nem egyértelmű, azt a nemzeti hovatartozás és az egyéni ízlésvilág nagyban befolyásolja.

INTRODUCTION

In the past decades, demand for high quality poultry meat produced by environmentally friendly production technologies increased in the developed countries. On the basis of this need, alternative poultry breeding technologies (free range and organic) have been developed. The alternative keeping systems and the almost double breeding period may obviously affect the texture quality of poultry meat (compared with intensive rearing) but the parameters of meat quality have not yet been investigated. These properties, however, could play important quality attributes for customers' acceptance (*Fletcher, 2002*).

According to some previous studies (*Lassaut et al., 1984, Touraille et al., 1985, Culioli et al., 1990*), French consumers prefer Label Rouge poultry over intensively reared chicken due to its better flavour and firm but not tough meat texture. Contrarily to the above mentioned experience, firmness of meat is rejected as an unfavourable property of meat by American consumers (*Green et al., 2005*).

Farmer et al. (1997) examined the effects of genotype, diet and stocking density on meat quality in a slow-growing (ISA 657) and a fast-growing (ROSS I) genotype. Both genotypes were reared under various combinations of free range and intensive diet conditions, high and low stocking density (ranged from 4.25 to 17 birds/m²) and breeding period (48 d or 83 d). According to the results, it was concluded that genotype affected the hardness of meat. Breast meat from ISA hybrids was harder and thigh meat was tender than those from Ross birds. Differences were explained by the older age and the various growth rates of the genotypes. This observation was confirmed in a previous study published by *Chambers et al. (1989)* as they drew the conclusion that thigh meat of modern, fast growing broilers was tenderer, than those hybrids that were reared several decades ago.

The effect of slaughtering age on the textural quality of meat was not proved exactly (*Sonaiya et al., 1990*). Results did not show significant differences between tenderness of breast and thigh meat of birds at d 34 and d 54. Similar conclusions were drawn by *Mohan et al. (1987)* who did not observe significant differences between the tenderness of meat over the range 6 to 8 weeks, however, juiciness of meat of female chickens increased up to 8 weeks of age.

Delpech et al. (1983) found no statistical difference between slaughtering age and tenderness and juiciness of meat. In contrast of these results, *Nakamura et al. (1975), Touraille et al. (1981ab)* and *Tawfik et al. (1990)* demonstrated a decrease in tenderness and an increase in firmness of chicken meat over the range 4 to 14 weeks.

Castellini et al. (2002) examined the effect of various (industrial and organic) production systems and breeding periods on broiler carcass and meat quality. Rearing conditions and age at slaughtering have been resulted statistically significant differences in share force of breast and thigh meat samples of Ross cockerels.

Sensorial attributes and meat quality of four chicken genotypes (one slow-growing broiler (S and G Poultry), two strains of medium-growing broilers (Redbro and Silvercross) and a commercial fast-growing broiler (Cobb-Vantress)

raised for 81, 67 or 53 d, respectively) were examined by *Fanatico et al.* (2006). Evaluating the meat hardness and flavour by organoleptic analysis, it was concluded that only slight difference existed among genotypes with different growth rates and rearing systems.

The object of our study was to determine the texturai attributes (hardness, gumminess, chewiness) of breast meat from one pure-bred, five cross-bred (Yellow Hungarian x S 77, Foxy Chick, Redbro, Hubbard Flex and Shaver Farm, respectively) and one commercial (Ross 308) genotypes. The effects of various breeding technologies and sex on meat parameters were also examined.

MATERIALS AND METHODS

The experiment consisted of 7 genotypes, such as pure bred Yellow Hungarian (YH) chickens, Yellow Hungarian pullets crossed with S 77 (YH x S 77), Foxy Chick (YH x FO), Redbro (YH x RB), Hubbard Flex (YH x HF) and Shaver Farm (YH x SF) meat-type cocks and Ross 308 commercial broiler chickens. Cross-bred hybrids and YH chickens were reared under free-range conditions for 84 days and Ross 308 chickens were industrially bred for 42 days.

Chickens reared under free-range conditions were fed *ad libitum* with commercial fattening feed produced by Lajta Hanság Ltd.

Chickens were slaughtered and breast meats were dissected from the carcasses. The skin was removed and the muscles were trimmed of the obvious fat and connective tissue. Samples from each bird were stored at 4 °C until analyzed within 24 hours.

Instrumental texture profile analysis (TPA) of breast meat was examined by Stevens QTS 25 Texture Analyser (Stevens Ltd., UK) at the laboratory of the University of Szeged, College of Food Industry, Department of Food Science. Stevens QTS 25 is a suitable appliance in the qualification of texture of different solid and semi-solid food products (*Horváth-Almássy et al.*, 2001, 2002ab; *Horváth-Almássy és Bara-Herczegh*, 2006) and evaluates the obtained values by software of Texture Profile Analysis. TPA of the treated samples was performed to determine hardness, gumminess and chewiness of breast meat measured these parameters on three examination points (*Picture 1.*).

Picture 1.: The examination points on the breast fillet



1. kép: Vizsgálati pontok a mellfilén

Penetration depth with compression was 5.00 mm, the speed of probe was 50 mm/min. Hardness (measured in g) means that force is needed to bite completely the meat and disintegration of meat before swallowing needs more mastication movements. Gumminess (measured in g): in relation to the necessary energy to crush and disintegrate the meat before swallowing. Chewiness: in relation to the necessary energy and the number of mastication movements to chew the meat before swallowing. Analyses were carried out on room temperature.

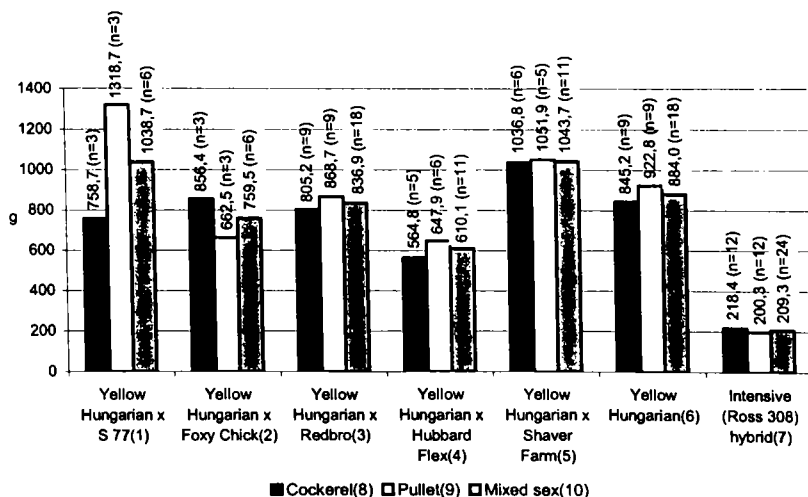
Statistical analysis

Data of textural parameters were evaluated using Microsoft Excel and Statistica Statsoft 6.0 computer programs. Mean and standard deviation from each obtained value of meat samples were calculated by Sváb (1981). A one-way ANOVA was used to analyze the effects of variables on hardness, gumminess and chewiness.

RESULTS AND DISCUSSION

The obtained hardness values of breast meat in YH x S 77 broilers were extremely high (1038.7 g) but the low number of samples did not allow us to draw considerable conclusions from these data. Apart from this, the highest hardness values were obtained in YH x SF (1043.7 g) and the lowest results were measured in YH x HF (610.1 g) crossbred genotypes. Industrial breeding chickens exhibited the lowest values for hardness (209.3 g) compared to the above mentioned crossbred genotypes (Fig. 1.).

Fig. 1.: The effect of genotype, sex and keeping technology on the hardness of breast meat

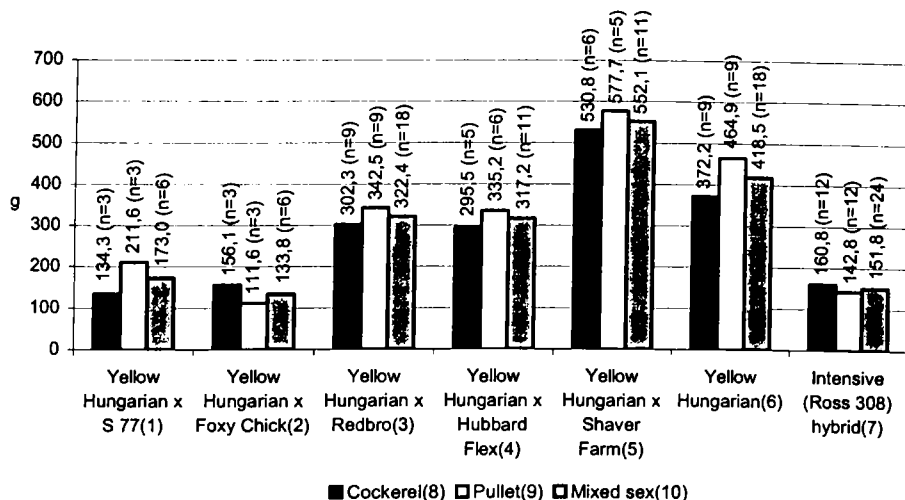


1. ábra: A genotípus, az ivar és a tartástechnológia hatása a mellhús keménységi értékére
sárga magyar x s 77(1), sárga magyar x foxy chick(2), sárga magyar x redbro(3), sárga magyar x hubbard flex(4), sárga magyar x shaver farm(5), fajtatiszta sárga magyar(6), intenzív (ROSS 308) hibrid(7), kakas(8), jérce(9), vegyes ivar(10)

Hardness of breast meat was not significantly affected by sex ($P < 0,05$) but hardness values of chickens reared by free range conditions were four times as high as the industrial Ross 308 broilers (865.5 g vs. 209.3 g, $P < 0,05$) (Table 1.).

Results of gumminess were higher in YH x SF hybrids (552.1 g) and pure bred Yellow Hungarian chickens (418.5) than those of YH x S 77 and YH x FO genotypes or industrially bred chickens (173.0 g, 133.8 g and 151.8 g, respectively) (Fig. 2.).

Fig. 2.: The effect of genotype, sex and keeping technology on the gumminess of breast meat



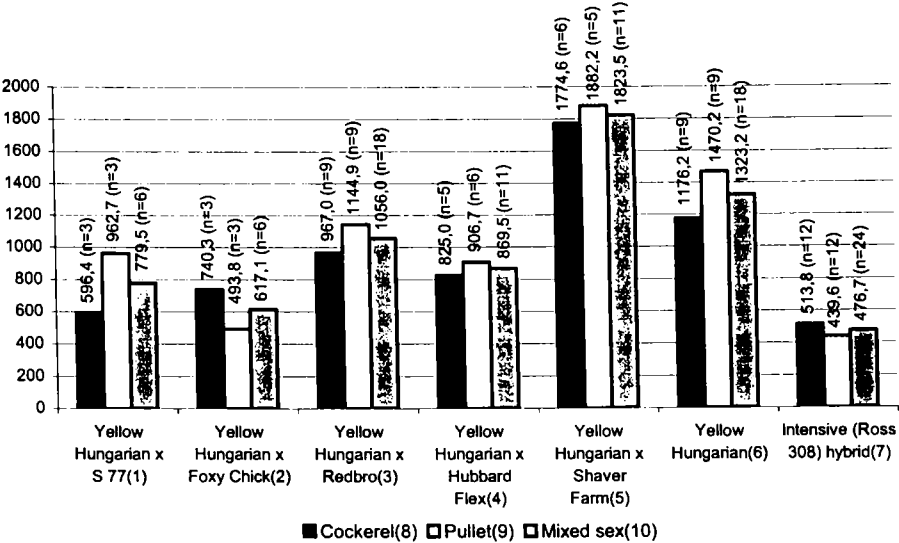
2. ábra: A genotípus, az ivar és a tartástechnológia hatása a mellhús gumissági értékére
lásd 1. ábra(1–10)

The effect of breeding technology on gumminess could be observed. The average gumminess value of chickens reared in free range system was significantly ($P < 0,05$) higher (353.4 g) compared to those of industrial Ross 308 chickens (151.8 g) (Table 1.).

Similarly to gumminess values, the highest chewiness average results were measured in YH x SF and pure bred YH genotypes (1823.5 and 1323.2 respectively) and the lowest (476.7) for industrial chickens (Fig. 3.).

Although the chewiness results were not significantly influenced by sex at $P < 0,05$ but the effect of keeping technology was demonstrated. Meat samples of chickens reared in free range conditions gave more than double chewiness values ($P < 0,05$) compared to those of industrial Ross 308 birds (1154.7 vs. 476.7, Table 1.).

Fig. 3.: The effect of genotype, sex and keeping technology on the chewiness of breast meat



3. ábra: A genotípus, az ivar és a tartástechnológia hatása a melihús rágóssági értékére lásd 1. ábra(1–10)

Table 1.

The effect of sex and keeping technology on the hardness, gumminess and chewiness of breast meat

	Sex(4)		Keeping technology(7)	
	Cockerel(5)	Pullet(6)	Free-range(8)	Intensive(9)
Hardness(1)	667,3	715,3	856,5*	209,3*
Gumminess(2)	287,9	316,0	353,4*	151,8*
Chewiness(3)	941,2	1021,9	1154,7*	476,7*

*means in the same line are significantly different (P<0.05)

2. táblázat: Az ivar és a tartástechnológia hatása a melihús keménységi, gumissági és rágóssági értékére keménység(1), gumisság(2), rágósság(3), ivar(4), kakas(5), jérce(6), tartástechnológia(7), szabad-tartás(8), intenzív tartástechnológia(9)

Hardness, gumminess and chewiness values of breast meat were unambiguously affected by genotype, keeping technology and combinations of these parameters. Similarly to the experiences of some previous studies (Nakamura et al., 1975; Touraille et al., 1981ab; Chambers et al., 1989; Tawfik et al., 1990; Farmer et al., 1997; Castellini et al., 2002) all the measured attributes were significantly (P<0,05) higher in chickens reared in free-range conditions compared to those of industrially reared birds (hardness: 865.5 vs. 209.3, gumminess: 353.4 vs. 151.8, chewiness: 1154.7 vs. 476.7).

Hardness of meat as a textural parameter means that more force is needed to bite completely the meat with incisors, to press the meat between molars and disintegration of meat before swallowing needs more mastication movements

and energy. Consideration of this parameter related to the nationality, the age and the taste of the consumers. In the view of French customers, free-range meat products are considered to be healthier and tastier due to their better flavour and firm meat texture (Lassaut *et al.*, 1984; Touraille *et al.*, 1985; Culioli *et al.*, 1990). In our opinion, Hungarian customers are expected to note a positive difference in taste between free-range and industrial conventional poultry because of their earlier experience related to taste of free-range products.

From these results, it is concluded that hardness, gumminess and chewiness values of chickens' breast meat reared in free-range conditions were higher compared to those of industrially reared broilers. This is due to the more natural breeding conditions which favour the development of muscles and reduce fatness (Castellini *et al.*, 2002). Although, the acceptance of various meat attributes by consumers are heterogeneous and is not yet well understood.

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