SLAUGHTERING PERFORMANCE OF *C. GARIEPINUS* AND *I. PUNCTATUS* AND MODIFICATIONS OF FILLETS STORED AT DIFFERENT TEMPERATURES

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Background

Among *Siluroidea* 28 families exist with about 1,200 species which can be found nearly exclusively in fresh water. A few years ago production of *Clarias gariepinus* (*C.g.*) and *Ictalurus punctatus* (*I.p.*) started in Europe, mainly in warmwater circulating systems or in ponds depending on the climate. There exists a series of studies using *I. p.*, but mainly focussing on pond-production, whereas experiments of *C. g.* are rare, mainly concerning product quality. Both species should be reared under the same conditions, with the same feed and simultaneously in the same water circulating system for examining fattening and slaughtering performance. As fish meat which should be sold in an unfrozen state, is usually transported on ice at about 0°C, and pH is important for toughness, dryness and cooking loss (1), the course of pH should be determined at temperatures of 1°C and 4°C.

Objectives

In order to investigate the influences of species and sex on fillet-percentage and to examine the influence of storage temperature on meat quality, *C.g.* and *I.p.* were slaughtered and characteristics of fillets were examined by using measurings of pH-value and fillet shape.

Material and Methods

C.g. and *I.p.* were reared in glass basins (150 l) from about 20 g live weight onwards. During 12 weeks previous to slaughtering day, 5-10 fish of one species each were put into 11 basins and all received the same feed (Wels E, Club-Kronen Tiernahrung GmbH, Wesel, Germany). On slaughter day, after 24 hours fasting, 24 specimen of *C.g.* and 20 of *I.p.* with approx. similar live weight were stunned by using Ethylenglycolmonophenylether. All fishes were eviscerated, filleted and skinned by the same person to avoid different cutting-technics. Fillets were placed flatly, inside above, on plastic-plates which had been spread with a thin layer of vegetable oil to enable easy contraction during rigor mortis. Left-side fillets were stored in a cooled incubator with air-circulation (Model 3300, Rubarth Apparate GmbH, Hannover, Germany, usable volume 170 l) at 1°C and right-side fillets in an identical device at 4 °C for 96 h. pH-values were measured at 45 min, 24 und 96 h post mortem (p.m.) using a WTW 522 pH-meter with an Ingold electrode at three different, but close together measuring points in the upper and cranial half of muscle. Length and width of fillets were measured at 45 min. 24, 48, 72 and 96 h p.m. always by the same person using a ruler. Fillets were weighed just after filleting and 96 h p. m.. Finally, it was subjectively evaluated whether under these experimental conditions gaping occured. Slaughter results were tested on influence of species, sex and their interaction. To analyse differences of fillet-percentage, live weight of fish was used as covariable. The influence of storage temperature was tested with all data of fillets using analysis of variance. Before testing influences of species and sex, mean values of fillets of each fish were used. In both cases, initial fillet-weight was used as covariable. Interactions between main factors were taken into consideration in variance-analysis. Differences between mean values were testet by LSM-procedure.

Results and Discussion

Significant difference of final live weight (Tab. 1) can be led back to different fattening performance of species reared in warmwater circulation systems fed on the same diet, which was documented as significantly different growth rate (2). Based on the higher live weight of *C.g.*, also fillet-weight was significantly higher, but the fillet-percentage of *I.p.* was significantly better. This may be explained by the different status of sexual maturity which was measured using the "gonadosomal index" (3). Few *I.p.* could be classified by external features as male or female, whereas each of *C.g.* showed clear sexual characteristics. Opposed to (4), no influence of sex could be observed, maybe because of the fact that our fish were about thrice heavier. Thus, in the beginning of storage experiment, starting-weight of fillets were significantly different between species, but not between sexes or storage temperature. The same relations occured with regard to shape factor of fillets, as cross-section of *C.g.* appears to be more circular than that of *I.p.* which possess an elliptical shape (2). Therefore, fillets of *C.g.* were thicker than of *I.p.*. This resulted in more weight per area, which is expressed in a higher shape factor. Since no significant differences in weight losses could be found at an average of 5.9±1.8 %, final weights mirrored difference of starting weights.

A significant difference of pH 45 min was found between species, whereby *C.g.* at 7.11 showed a higher value by 0.6 units. The significant difference remained all over the storage period, but the final pH of *C.g.* was lower by 0.18 units at 6.29. pH of live fish depends on species but ranges at about 7.00 (5) and p.m. modifications mainly depend on energy reserves, temperature and encymatic activities (1).

Table 1. Slaughtering results[1)]

Species	C. gariepinus		I. punctatus		Signification level of main factors		
Sex	male	female	male	female	Species	Sex	Interaction
n	14	10	15	5			
Live weight, g	1361[a] ± 261	1440[a] ± 240	1047[b] ± 189	1032[b] ± 74	***	-	-
Weight of fillets, g	433[a] ± 79	425[a] ± 71	336[b] ± 67	364[ab] ± 27	***	-	-
Fillet percentage, %	31.0[a] ± 1.6	29.6[b] ± 1.9	32.0[a] ± 1.5	35.3[c] ± 1.0	*	-	***

[1)] Values within the same line sharing no identical letter are significantly different (p<0.05); -, *, ***: p >0.10, <0.05, < 0.001

Table 2: Parameters of fillet quality

Influence	Species				Sex				Storage temperature			
Factor	C. gariepinus		I. punctatus		male		female		1 °C		4 °C	
n	24		20		29		15		44		44	
Starting weight of fillet	214 ± 37	***	171 ± 30		191 ± 44		202 ± 33		197 ± 40		194 ± 41	
Final weight of fillet	202 ± 35	***	162 ± 29		180 ± 41		191 ± 31		185 ± 38		182 ± 38	
Weight loss, %	6.1 ± 0.7		5.7 ± 1.3		6.0 ± 1.2		5.8 ± 0.5		5.6 ± 2.1		6.0 ± 1.3	
Shape factor of fillet [1)]	9.3 ± 0.6	***	7.5 ± 0.5		8.3 ± 1.2		8.6 ± 0.9		8.5 ± 1.2		8.3 ± 1.1	
Lenght/Width	3.29 ± 0.23	***	2.49 ± 0.12		2.91 ± 0.49		2.95 ± 0.36		2.85 ± 0.47	*	3.00 ± 0.45	
pH 45 min	7.11 ± 0.12	***	6.51 ± 0.47		6.77 ± 0.50		6.97 ± 0.27		6.88 ± 0.30		6.79 ± 0.72	
pH 24 h	6.17 ± 0.07	***	6.45 ± 0.07		6.31 ± 0.17		6.27 ± 0.12		6.31 ± 0.14	*	6.27 ± 0.17	
pH 96 h	6.29 ± 0.08	***	6.47 ± 0.06		6.39 ± 0.12		6.33 ± 0.10		6.39 ± 0.12	*	6.28 ± 0.45	
pH-difference												
pH 45 - 24	0.94 ± 0.12	***	0.06 ± 0.48		0.46 ± 0.62		0.70 ± 0.35		0.57 ± 0.42		0.52 ± 0.81	
pH 24 - 96	-0.12 ± 0.05	***	-0.02 ± 0.04		-0.08 ± 0.08	+	-0.07 ± 0.04		-0.08 ± 0.06		-0.01 ± 0.45	
Changes of width, %												
24 h	4.3 ± 3.3		3.3 ± 2.2		4.1 ± 3.2		3.4 ± 2.1		3.4 ± 3.5		4.3 ± 3.9	
48 h	5.8 ± 2.8	*	2.5 ± 1.9		4.4 ± 3.4		4.2 ± 2.0		1.8 ± 14.6		4.8 ± 3.9	
72 h	6.5 ± 3.1	**	3.5 ± 2.1		5.2 ± 3.2		4.9 ± 2.9		4.3 ± 3.9	+	6.0 ± 3.9	
96 h	4.9 ± 5.0		3.4 ± 1.7		4.1 ± 4.5		4.3 ± 2.2		3.6 ± 3.5		4.8 ± 6.9	
Changes of length, %												
24 h	-2.4 ± 1.7	***	-6.3 ± 1.7		-4.4 ± 2.6		-3.7 ± 2.7		-4.0 ± 3.1		-4.3 ± 2.5	
48 h	-2.8 ± 1.4	***	-7.0 ± 1.9		-5.0 ± 2.7		-4.1 ± 2.6		-4.6 ± 3.1		-4.8 ± 2.6	
72 h	-2.7 ± 1.3	***	-7.0 ± 2.0		-4.9 ± 2.8		-4.1 ± 2.4		-4.6 ± 3.2		-4.7 ± 2.6	
96 h	-2.8 ± 1.2	***	-7.3 ± 2.2		-5.1 ± 3.1		-4.3 ± 2.3		-5.0 ± 3.3		-4.7 ± 3.1	

[1)] Shape factor =weight (g)/length (mm) * width (mm); +, *, **, ***: p <0.1, <0.05, <0.01, <0.001

If fish uses up its energy before slaughtering owing to stress, pH value already diminishes during life time and remaining energy allows only a slight pH-decrease (5). *C.g.* and *I.p.* were identically handled before and during slaughtering process but probably *C.g.* were not as sensitive to procedures as *I.p.* These explanations are supported by the pH-differences which describe the pH-course. During the first 24 h p.m., pH-level decreased on an average of about 0.5 units but then a small increase appeared, mainly released by protease activities. These trends can also be seen regarding sex and storage temperature but no influence of sex on pH could be observed. Higher pH-values at 24 and 96 hours p.m. at 1°C are supposed to be a consequence of lower encyme activities but these were not be investigated. Also, the higher starting pH could be responsible because there were similar pH changes. As fillets had been cut immediately after slaughtering, a faster pH decrease than in fillets remaining in carcasses is possible (6). Different body-shapes between species also resulted in a different lenght/width-factor. *C.g.* are comparatively longer than *I.p.* but rigor mortis contractions percentage is significantly lower by more than a half. This is astonishing because lower pH normally results in higher rate of protein denaturation (7). Fillets contracted during rigor mortis and therefore, became wider which was to be seen at an average of 4.9 % reduced length and simultaneously 4.2 % increased width. Sex and storage temperature showed no influences on these modifications. How far these are not only caused by pH variations but also by weight losses is uncertain.

Conclusions

C.g. showed better fattening and slaughter performance than *I.p.* when reared in warmwater circulating systems and, thus, this species should be preferred for such systems. Whereas sex and storage temperature had little or no influence on fillet shape, pH course p.m. and weight loss, differences appeared between *C.g.* and *I.p.*. As contractions of fillets were very low in *C.g.*, cutting immediately after slaughtering is possible in order to keep the former length. Whether different meat characteristcs between species depend on different nutrient composition and might influence consumers' acceptance should be the aim of further investigations.

Pertinent literature

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