Scientific Annals of Polish Society of Animal Production - Vol. 9 (2013), No 1, 69-73

Utility value and meat quality of rainbow trout (*Oncorhynchus mykiss*) with regard to the weight of fish

Piotr Skałecki, Mariusz Florek, Anna Litwińczuk, Agnieszka Zaborska

University of Life Sciences in Lublin,
Department of Commodity Science and Processing of Animal Materials,
ul. Akademicka 13, 20-950 Lublin, e-mail: skalka_p@op.pl

The aim of this study was to evaluate the utility value and meat quality of two groups of rainbow trout. The study involved 18 trouts fished on the farm localized in the Lublin voivodeship, which were divided into two groups of assortment: S – up to 350 g (n=10) and D – above 350 g (n=8). Both groups of fish, despite the substantial difference in their weight, had the similar share of meat in the fish (51-52%). Meat of larger trout (over 350 g) was characterised by more favorable chemical composition.

KEY WORDS: fish / rainbow trout / meat quality

Production of rainbow trout in Poland in the last 30 years has been developing very dynamically (growing by approx. 8.3% annually), in 2006 reaching 17 thousand tonnes and exceeding the production volume of carp [11].

Average fish consumption in Poland is approx. 13 kg per capita, of which the greatest consumption level among domestic freshwater fish is recorded for rainbow trout (in 2008 amounting to 0.44 kg live weight) [4].

Increased imports of Norwegian salmon, observed in Poland over the recent years, and its relatively high price have contributed to the growing demand for large trout, which is to be consumed "salmon style", i.e. fish with mean individual weight exceeding 1.5 kg. It also needs to be remembered that large rainbow trout are characterised by superior taste and dietary value. Most commercially available trout are fish aged over 1 year and individual body weight ranging from 300 to 600 g. In contrast, within this species small fish are considered to be of lower utility value. This results mainly from greater losses during preliminary processing and their lower fat content, as a rule leading to a greater water content in meat [6].

The aim of this study was to assess utility value and meat quality in rainbow trout depending on body weight of fish.

Materials and methods

Analyses were conducted on 18 rainbow trout, caught in a fish farm in the Lubelskie province. Based on their body weight (in g) the fish were assigned to two grade classes in accordance with the Polish Standard, i.e. S – max. 350 g (n=10) and D – over 350 g (n=8).

Total length of fish and their body length (in cm) were measured using a ruler. Preliminary processing consisted in scaling (removal of scales from their skin), gutting (opening of the body cavity, removal of the gut and blood clots), beheading (separation of the head from the rest of the body) and fin removal (cutting off the caudal, dorsal, pectoral and ventral fins at approx. 0.5 cm from their base).

Physico-chemical quality of meat was evaluated based on the following measurements: pH – with a TYP pH-meter with a glass electrode, electrical conductivity (mS/cm) – with a PQM I/Kombi apparatus, lightness (CIE L*) of fresh-cut fillet surface after 30-minute exposure using a Minolta CR-310 apparatus (CIE, 1976). Measurements of the physico-chemical properties were taken after 24-hour cold storage at a temperature of +4°C.

Conventional methods were applied to determine the basic chemical composition of meat, i.e. water content by drying (103°C) according to the PN-ISO 1442:2000 standard; ash – by incineration in a muffle furnace (550°C) according to PN-ISO 936:2000; crude protein according to Kjeldahl with a Büchi B-324 apparatus according to PN-75/A-04018/A23:2002; fat according to Soxhlet (using n-hexane as a solvent) with a Büchi B-811 apparatus according to PN-ISO 144:2000. Gross and net energy were calculated based on the contents of crude protein and fat. Calculations were performed using physical values (for protein 5.65 kcal=23.64 kJ, for fat 9.45 kcal=39.54 kJ) and physiological (Atwater) energy equivalents (for protein 4.0 kcal=16.76 kJ, for fat 9.0 kcal=37.66 kJ).

Statistical analysis was performed using a one-way analysis of variance with the StatSoft STATISTICA ver. 6.0 programme, while the significance of differences was determined using Tukey's test ($P \leq 0.05$ and $P \leq 0.01$).

Results and Discussion

Results of biometric measurements are presented in Table 1. As it could have been expected, trout of grade D, in comparison to grade S, were characterised by significantly ($P \leq 0.01$) greater mean body dimensions, while the share of meat in the body was comparable (S – 51.1%, D – 52.0%).

A lower meat content in rainbow trout was reported by Litwińczuk et al. [7], i.e. for fish with a body weight of up to 0.3 kg it was 45.61%, while for those above 0.3 kg it was 49.16%. However, this difference was statistically non-significant.

The course of glycolytic changes in the muscle tissue of animals is affected by numerous factors before, during and after slaughter, the most important of which include animal handling and the occurrence of a stress response [10]. In this study meat of trout from the compared grades did not differ significantly in terms of pH and electrical conductivity (EC). Meat of fish from grade D was significantly ($P \leq 0.01$) lighter (Table 2). In turn, Litwińczuk et al. [7] showed significant differences in pH of meat from small trout of max.

Table 1
Morphometrical measurements of fish

Specification	Group			
	S		D	
	$\bar{x}$	SD	$\bar{x}$	SD
Body weight (g)	168.46^{A}	28.57	403.93^{B}	40.39
Total length (cm)	25.00^{A}	1.47	34.00^{B}	1.84
Body length (cm)	22.83^{A}	1.67	31.20^{B}	1.60
Meat weight (g)	81.16^{A}	12.69	206.10^{B}	28.06
Meat percentage	51.09	1.39	51.96	1.70

A, B – means in rows marked different letters differ significantly at P≤0.01

Table 2
Physicochemical traits of fish meat

Specification	Group			
	S		D	
	$\bar{x}$	SD	$\bar{x}$	SD
pH_{24}	6.39	0.11	6.37	0.35
EC_{24} (mS/cm)	6.94	0.92	7.87	1.35
L*	46.06^{A}	2.26	52.33^{B}	1.20

A, B – means in rows marked different letters differ significantly at P≤0.01

0.3 kg (7.17) in comparison to heavier fish (6.29). According to Marx et al. [8] the boundary value of pH_{24} for fresh fish meat is 6.5. According to a study by Yao et al. [13], electrical conductivity is connected with selected indexes of muscle tissue freshness in carp during storage.

The shares of chemical components in trout meat differed significantly (P≤0.01) depending on body weight of fish (Table 3). A greater share of water (by 2.67 pp) and lower shares of ash (by 0.41 pp), protein (by 2.8 pp) and fat (by 1.32 pp) as well as a lower calorie content were recorded in meat of grade S rainbow trout. A consequence of greater water contents and lower crude protein contents was a significantly higher hydration rate in muscle protein (water:protein proportion) in trout of grade S.

The chemical composition of fish meat, apart from genetic factors, depends also on water quality parameters (pH and temperature), feed type and intake, as well as physical activity, age and body size of fish [1, 3, 9]. Many authors indicate that fat content increases with fish size, which to a considerable degree is connected with nutrition. In contrast, an inversely proportional dependence is observed for water content [5, 12]. In earlier studies Litwińczuk et al. [7] also showed a significantly greater fat content (by almost 2 pp) in the

Table 3
Chemical composition and calorific value of fish meat

Specification	Grupa – Group			
	S		D	
	$\bar{x}$	SD	$\bar{x}$	SD
Water (%)	77.30^{B}	1.85	74.63^{A}	0.60
Ash (%)	0.85^{a}	0.29	1.26^{b}	0.39
Protein (%)	19.85^{A}	0.34	22.65^{B}	0.12
Fat (%)	3.15^{A}	0.12	4.47^{B}	0.47
W/B*	3.92^{B}	0.38	3.30^{A}	0.03
Gros calorific value (kJ/100 g)	593.59^{A}	53.32	712.03^{B}	17.17
Net calorific value (kJ/100 g)	451.13^{A}	37.33	547.82^{B}	16.76

*W/B – water:protein proportion
Means in rows marked different letters differ significantly: a, b at P≤0.05; A, B at P≤0.01

grade of larger fish (over 0.3 kg). In turn, the cited authors found a different dependence in terms of protein content, i.e. the grade of larger fish (over 0.3 kg) contained significantly less protein (by 2.08 pp). Cieśla [2] for a 100 g portion of rainbow trout fillet reported an average water content of 72%, as well as 19% protein and 6% fat contents.

Summing up it may be stated that the two compared grades of rainbow trout, despite a significant difference in their body weight, had similar shares of meat, amounting to 51-52%. Meat of larger trout (over 350 g) was characterised by a more advantageous chemical composition.

REFERENCES

1. BUCHTOVA H., SVOBODOVA Z., KRIŽEK M., VACHA F., KOCOUR M., VELIŠEK J., 2007 – Fatty acid composition in intramuscular lipids of experimental scaly crossbreds in 3-year-old common carp (*Cyprinus carpio* L.). ***Acta Veterinaria Brno*** 76, S73-S81.
2. CIEŚLA M. , 2008 – Czy jedząc ryby zawsze stajemy się zdrowsi? ***Przegląd Hodowlany*** 11, 28-31.
3. FAUCONNEAU B., ALAMI-DURANTE H., LAROCHE M., MARCEL J., VALLOT D., 1995 – Growth and meat quality relations in carp. ***Aquaculture*** 129, 265-297.
4. HRYSZKO K., 2009 – Sektor rybny w Polsce – tendencje rozwojowe. ***Przemysł Spożywczy*** 9, 14-19.
5. KAUSHIK S.J., 1995 – Nutrient requirements, supply and utilization in the contest of carp culture. ***Aquaculture*** 129, 225-241.
6. KUŹMIŃSKI H., 2012 – Populacje samicze pstrąga tęczowego (*Oncorhynchus mykiss*) w polskiej akwakulturze. Materiały XXXVII Krajowej Konferencji-Szkolenia dla Hodowców Ryb Łososiowatych, Rumia, 165-174.

7. LITWIŃCZUK A., BARŁOWSKA J., GRODZICKI T., WARZYBOK J., 2002 – Wartość użytkowa i skład chemiczny mięsa pstrągów z rzek Podkarpacia. ***Annales Universitatis Mariae Curie-Skłodowska, Sec. EE, Zootechnica,*** 20, 263-266.
8. MARX H., BRUNNER B., WENZIERL W., HOFFMANN R., STOLLE A.,1997 – Methods of stunning freshwater fish: impact on meat quality and aspects of animal welfare. ***Zeitschrift für Lebensmittel-Untersuchung und -Forschung A*** 204, 282-286.
9. MENOYO D., LOPEZ-BOTE C.J., DIAZ A., OBACH A., BAUTISTA J.M., 2007 – Impact of n-3 fatty acid chain length and n-3/n-6 in Atlantic salmon (*Salmo solar*) diets. ***Aquaculture*** 276, 248-259.
10. MERKIN G.V., ROTH B., GJERSTAD C., DAHL- PAULSEN E., NORTVEDT R., 2010 – Effect of pre-slaughter procedures on stress responses and some quality parameters in sea-farmed rainbow trout (*Oncorhynchus mykiss*). ***Aquaculture*** 309, 231-235.
11. SEREMAK-BULGE J., 2008 – Rynek i spożycie ryb w 2007 roku i perspektywy jego rozwoju. W: Pstrągarstwo – nowe wyzwania, nowe perspektywy (red. Agroprofit Maciej Poczman). Materiały XXXIII Krajowej Konferencji-Szkolenia Hodowców Ryb Łososiowatych organizowanej przez Stowarzyszenie Producentów Ryb Łososiowatych, Lębork, 33-42.
12. VRANIĆ D., TRBOVIĆ D., ĐINOVIĆ J., TEODOROVIĆ V., SPIRIĆ A., MILIJAŠEVIĆ M., PETRONIJEVIĆ R., 2010 – Mlađ i konzumna kalifornijska pastrmka (*Oncorhynchus Mykiss*): hemijski i masnokiselinski sastav. 14. Međunarodni simpozijum tehnologije hrane za životinje-12. Međunarodni simpozijum "NODA", Novi Sad, 19–21 oktobar, 2010, Zbornik radova, 51-57.
13. YAO L., LUO Y., SUN Y., SHEN H., 2011 – Establishment of kinetic models based on electrical conductivity and freshness indictors for the forecasting of crucian carp (*Carassius carassius*) freshness. ***Journal of Food Engineering*** 107, 147-151.