

DRESSING PERCENTAGE OF 3-YEAR OLD CARP FROM CAGE PRODUCTION SYSTEM

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RANDMAN TROGODIŠNJEG ŠARANA IZ KAVEZNOG SISTEMA UZGOJA

Apstrakt

Uzgoj šarana (*Cyprinus carpio* L.) u kaveznom sistemu predstavlja posebnu vrstu intenzivne proizvodnje. Odlikuje se malim početnim ulaganjima u izgradnju kaveznog ribnjaka, ne zahteva značajno angažovanje radne snage i obezbeđuje veliku proizvodnju po jedinici zapremine.

Izbor lokacije je od velikog značaja jer utiče na ekonomsku održivost, proizvodnju i mortalitet šarana. U odnosu na druge uzgojne sisteme, utvrđeno je da u kaveznom sistemu morbiditet i mortalitet mogu značajno varirati i u slučaju odstupanja vrednosti parametara kvaliteta vode od optimalnih, gubici mogu nastupiti brzo i biti dramatični.

Nedostatak kaveznog sistema gajenja ogleda se u olakšanoj transmisiji bolesti i zagađenju vodenog ekosistema u kome je kavezni sistem postavljen, što se može sprečiti uvođenjem zaštitnih sistema. Uz poštovanje načela dobre proizvođačke prakse, održavanjem dobrog kvaliteta vode i optimalno izbalansiranu hranu primerenu starosnoj kategoriji uzgajanog šarana, očekivan mortalitet je 1-5%.

Zahtevi savremenog tržišta su sve više usmereni ka obrađenoj ribi, posebno filetima. Uklanjanjem kože i odstranjivanjem unutrašnjih organa i intramuskularnih kostiju, fileti šarana i ostalih ciprinida koje se gaje u polikulturi sa šaranom, postaju visokovredni obroci, koji se lako i brzo spremaju. Randman riba je ekonomski parametar čija je vrednost značajna pri svim tehnološkim operacijama vezanim za preradu ribe. Iskazuje se kao odnos primarno obrađenog trupa u odnosu na masu žive ribe.

Odnos jestivog i nejestivog dela trupa ribe može značajno da varira u zavisnosti od vrste, mase i veličine ribe i sezone ulova). Od njega direktno zavisi ekonomičnost proizvodnje i neopravdano je zanemaren kao parametar u istraživanjima.

Razlika u randmanu između različitih linija i njihovih hibrida javlja se zbog različitog oblika, dužine glave, debljine i širine tela. Randman riba značajno je povoljniji od randmana kod ostalih vrsta životinja. Delovi koji se odbacuju mogu sadržati sve ili samo neke delove glave, krljušti, kože, creva, gonada i peraja.

Cilj istraživanja bio je određivanje randmana kod trogodišnjeg šarana poreklom iz kaveznog sistema uzgoja. Uzorkovanje je obavljeno iz dva kavezna sistema na Tikveškom jezeru (Makedonija) (41°20'51"N 21°57'58"E) i iz jednog na Bilečkom jezeru (Bosna i Hercegovina) (42°49'31"N 18°26'17"E). Ishrana riba vršena je kompletnim krmnim smešama različitih proizvođača. Iz svakog kaveznog sistema uzorkovano je po 8 jedinki muškog i 8 jedinki ženskog pola (ukupno po 24 jedinke svakog pola).

Morfometrijske osobine riba utvrđene su sa ciljem da se ispita uticaj pola na randman trogodišnjeg šarana gajenog u kaveznom sistemu. Nakon što su izlovljeni, šarani su držani na ledu. Krljušt je skinuta ručno nazubljenim nožem. Glava je odsečena cirkularnim rezom ispred pojasa pektoralnog peraja tako da je peraje ostalo na trupu. Peraja su odsečena na početku perajnih žbica. Egzenteracija organa zajedno sa gonadama obavljena je ručno. Dobijeni su obrađen trup, koji podrazumeva trup ribe bez krljušti, peraja, unutrašnjih organa i glave. Posle odstranjivanja krljušti, unutrašnji oragni, gonade, glava, peraja i obrađen trup su izmereni. Rezultati su obrađeni t-testom kako bi se utvrdio uticaj pola na randman trogodišnjeg šarana gajenog u kaveznom sistemu proizvodnje.

U odnosu na pol (ženke naspram mužjaka šarana) pažnja je usmerena na parametre koji su važni sa aspekta gajenja i što povoljnijeg randmana.

U našem istraživanju randman je određen kao odnos mase cele ribe i mase trupa bez glave, krljušti, peraja i unutrašnjih organa. Rezultati dobijeni u našem istraživanju pokazuju veću težinu ženskih u odnosu na muške jedinke (FW), ali nemaju statističku značajnost.

Ukupna dužina (TL), standardna dužina (SL) i dužina trupa (CL) ženki u odnosu na mužjake imaju statistički značajnu razliku ($p < 0,01$), dok razlike u telesnoj masi ženki i mužjaka nisu statistički značajne. Rezultati dobijeni merenjem težine trupa (CW) i težine unutrašnjih organa (VW) ženki u odnosu na iste parametre kod mužjaka imaju statistički značajnu razliku ($p < 0,01$). Vrednosti dobijene merenjem težine glave (HW), težine gonada (GW) mužjaka, kao i vrednosti gonadosomatskog indeksa (GSI) u odnosu na vrednosti istih parametara kod ženki imaju statistički značaj ($p < 0,01$). Razlike u dužini glave (HL), visini tela (BH), masi peraja (FW), masi jedinki (FW) i obrađenih fileta (FilletW) mužjaka i ženki, nemaju statistički značaj. Vrednosti dobijene izračunavanjem relativne težine fileta i randmana uzorkovanih trogodišnjih jedinki šarana muškog i ženskog pola nemaju statistički značajnu razliku.

Ključne reči: Šaran, kavezni sistem, pol, randman
Keywords: carp, female, male, dressing percentage

INTRODUCTION

Carp (*Cyprinus carpio* L.) is domesticated in every continent except Antarctica, owing to its ability in adapting to different values of water quality parameters, including tolerance to very low dissolved oxygen concentrations. Considering the benefits that are reflected by the extensive reproductive abilities, breeding and prime selection potentials, and high resistance to various diseases, it is not surprising that carp represents

the dominant species in all counties with prerequisites for extensive, semi-intensive and intensive freshwater fish production. The carp growth in different production systems depends on many factors, such as varietal, density, welfare and fish feed with proper nutrients along with geographic location.

Cage production system for carp is a special type of intensive production. It is characterized by lower initial investments in cage construction and minimal labor engagement, ensuring high production yield per volume capacity of water contained in the constructed units. Modern cages are constructed from metal and synthetic polymers (Mihailovic et al., 2007). Cage has to be robust enough to endure associated hazards such as winds and waves, uncomplicated servicing and maintenance. Location choice is critical as it affects the production and mortality of the produce (Carp) directly impacting the profitability of the production unit.

Below listed are three-selection criterion considered for selection of sites for cage culture (Bogut et al., 2007).

1. Physical and chemical parameters including temperature, dissolved oxygen concentration, water flow, pollution and algal blooms.
2. Factors relating to the choice of location taking into account weather conditions, shelter, substrate, water currents and the degree of blur. Additionally the shape and size of the cage and the depth to which they are installed.
3. Profitability of the farm, and includes legal aspects, accessibility, facilities, security, economic and social conditions.

Superior production practices, quality of water and optimally balanced diet appropriate for the cultured carp category, expected mortality rate is 1-5%. Compared to other breeding systems, it was found that the cage system morbidity and mortality could vary significantly in the case of deviation in the values of water quality parameters from the optimum, the losses can occur quickly and be dramatic. (Orajić et al., 2007)

Shortcoming of cage production system is reflected through allowing of disease transmission and aquatic ecosystems contamination where the cage system is set up, this can be prevented by protective systems introduction.

Modern market demands are increasingly directed towards processed fish, especially fillets (Hough, 1993; Vallod, 1995). By removing the skin, internal organs and intramuscular bones, fillets of carp and other cyprinids grown in polyculture along with the carp, become high value meals that are easily and quickly prepared (Lin et al., 1989).

Dressing percentage of fish is an economic parameter with significant value attached to it, in all technological operations related to fish processing. It is expressed as the ratio of the primary processed carcass (dressed) relative to carcass weight of live fish.

The ratio of edible and non-edible part of the fish carcass can vary significantly depending on the species, weight, size of the fish and season catch (Baltic and Teodorović, 1997). Since the dressing percentage directly influences the economy (profitability) of production, it is unjustly neglected as the parameter in scientific research/studies (Lju-bojević et al, 2012).

The difference in yield of different lines and their hybrids occur due to different body shape, head length, width and fat of the body. Dressing percentage of fish is significantly higher comparatively than the yield of other animal species (Ćirković et al., 2002). Parts that are rejected may include all or some parts of the head, scales, skin, intestine, gonads and fins.

According to Dunhamu et al. (1983) fish carcass primary handling involves removal of the head, scales and internal organs, while Lovell (1981) reference states that primary

treatment involves the removal of skin, dorsal and pectoral fins, head and abdominal organs cavity, with the tail present. Naumovski (1991) and Tumbas (1976) define fish carcass primary handling as a process which include removal of the tail fin.

In this study, yield was determined as the ratio of the fish weight and the carcass without the head, scales, fins and internal organs.

MATERIALS AND METHODS

The specimens of 3-year old carp from cage production system were sampled in the Tikveš lake in Macedonia (41°20'51"N 21°57'58"E) (two groups) and from the Bilećko Lake in Bosnia and Herzegovina (42°49'31"N 18°26'17"E) (one group). Fish were fed with a completed feed mixture from different manufacturers. From every cage system, 8 male and 8 female samples are taken (24 individuals of each sex). For the statistical analysis of the results, software package Microsoft Office Excel 2010 and Data Analysis ToolPack, were used. Statistical t-test was used for mean values determination. Morphometric characteristics determination, (described by Baltić and Teodorović, 1997) of 3-year old carp specimens from cage production system is conducted in order to evaluate the dressing percentage in relation to sex. After being harvested, the carp were kept on ice. The scales are removed with a serrated knife. The head is cut off with a circular incision in front of the pectoral fins (Gela and Linhart, 2000). The internal organs along with the gonads were removed manually and a processed carcass (without scales, fins, internal organs and head) is obtained. After dissection, the internal organs, gonads, head, fins and carcass were measured. The obtained results were used to determine the relative percentage ratio in relation to the initially measured fish body weight.

RESULTS

The biometric parameters of 3-year old male and female carp specimen are presented in the Table 1: (TL-total length, SL-standard length, CL-body length, HL-head length and BH-body height), and weight parameters (FW-fish weight, CW-carcass weight, FW- fillet weight, HW- head weight, FW-fin weight, GW-gonad weight, VW- viscera weight). After dissection acquired data were used to calculate the percentage of fillets, head, fins, viscera and waste per fish weight, as well as important indices such as dressing percentage (DP), gonadosomatic index (GSI) and relative fillet weight. The obtained results were used to determine the relative percentage ratio of each parameter in relation to the initially measured fish body weight. For the statistical analysis of the results, software package Microsoft Office Excel 2010 and Data Analysis ToolPack, were used. Statistical t-test was used for mean values determination.

Table 1. The values of biometric parameters in carp (*Cyprinus carpio*) in relation to sex (females, males) Values in the table are the mean values \pm SD (n = 24), values in the same row with different letters in superscript differ significantly at $p < 0,01$.

| Parameter | Unit | Female n=24 mean \pm S.D. | Male n=24 Mean \pm S.D. |
|------------------------------|------|----------------------------------|--------------------------------------|
| Biometric parameters | | | |
| Total length (TL) | mm | 457,5 \pm 13,72 ^a | 438 \pm 8,18 ^b |
| Standard length (SL) | mm | 393,88 \pm 16,76 ^a | 369,87 \pm 21,83 ^b |
| Carcass length (CL) | mm | 322,5 \pm 13,72 ^a | 308 \pm 8,18 ^b |
| Head length (HL) | mm | 87,92 \pm 2,61 | 87,7 \pm 2,8 |
| Body height (BH) | mm | 126 \pm 4,8 | 125,54 \pm 6,51 |
| Weight parameters | | | |
| Fish weight (FW) | g | 1550,23 \pm 55,59 | 1495,47 \pm 109,09 |
| Carcass weight (CW) | g | 1010,12 \pm 19,57 ^a | 947 \pm 5 \pm 72,68 ^b |
| Fillet weight (filletw) | g | 750,42 \pm 33,81 | 727,5 \pm 51,29 |
| Head weight (HW) | g | 235,96 \pm 30,98 ^b | 263,89 \pm 27,35 ^a |
| Fins weight (FW) | g | 40,05 \pm 4,59 | 38,88 \pm 5,4 |
| Viscera weight (VW) | g | 267,18 \pm 57,13 ^a | 222,14 \pm 24,64 ^b |
| Gonad weight (GW) | g | 56,57 \pm 3,21 ^b | 59,61 \pm 2,89 ^a |
| Calculated parameters | | | |
| GSI | | 3,66 \pm 0,26 ^b | 4,01 \pm 0,4 ^a |
| Dressing percentage | % | 65,57 \pm 2,25 | 63,57 \pm 5,49 |
| Fillet weight relative | % | 48,41 \pm 1,29 | 48,6 \pm 2,02 |

The results obtained in our study showed slightly higher body height (BH) and head length (HL) values in the females compared to the males. Weight parameters obtained (fish weight, fin weight and fillet weight) had no statistically significant difference ($p > 0.05$) Total length (TL), standard length (SL), and carcass length (CL) of females compared to males had a statistically significant difference ($p < 0.01$). In female carp, significantly higher carcass weight (CW) and viscera weight (VW) were found ($p < 0.01$). Significant differences ($p < 0.01$) were found in head weight (HW) and gonad weight (GW) as well in gonadosomatic index value (GSI) in the favor of male carps.

DISCUSSION

Carp (*Cyprinus carpio* L.) belongs to the species that have expressed a high degree of sexual dimorphism. The results of research conducted by Bay et al. (2006) showed almost the same growth rate of male and female 3-year carp from four different sub-groups examined. The faster growth of female carp was confirmed by research of Cherfasa et al. (1996). Analysis of the relation between sexual maturity and growth rate of the Chinese and European carp conducted by Hulata et al. (1995) showed that the beginning of sexual maturity has a negative impact on the physical growth of many species of fish. The production of sex hormones during sexual maturation, especially their accumula-

tion, inhibits growth as a result of the reaction between sex hormones and growth hormones. Due to the different time of reaching sexual maturity amongst different sexes, the results of this study are consistent with the conclusion that males attribute of reaching sexual maturity earlier than females, utilize more nutrients for development of the gonads, while sexually immature female specimen(s) during the maturation period go through intensive physical growth.

CONCLUSION

The results of this study demonstrate greater weighing females compared to males (FW), but of no statistical significance.

The results gonad weight (GW) of males and values of the gonad somatic index (GSI) of males had a statistically significant difference compared to the values of the same parameters in females ($p < 0.01$). Total length (TL), standard length (SL) and body length (CL) of females compared to males had a statistically significant difference ($p < 0.01$), while the difference in weight of females and males were statistically of little significance. Results obtained by measurements of carcass weight (CW) and the weight of the internal organs (VW) females compared to males with the same parameters demonstrated statistically significant difference ($p < 0.01$). The difference in values obtained by measuring the weight of the head (HW), gonad weight (GW) of males, and gonad somatic index GSI values compared to the values of the same parameters in females demonstrated variance of statistical significance ($p < 0.01$).

Analytical Differences in the head length (HL), body height (BH), body weight of individuals (FW) and fin weight (FW) of males and females demonstrated variance of no statistical significance.

Values obtained by calculating the relative weights and fillet yield of three-year sampled carp male and female demonstrated no variance of statistical difference. Production of 3-year old carp in cage production system is economically unprofitable compared to the production of a 2-year old carp, due to utilization of more nutrients and energy received in feed during sexual maturation for development of the gonads.

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REFERENCES

Baltić, M., Teodorović, V. (1997): Higijena mesa riba, rakova i školjki. Veterinarski fakultet. Beograd.

Buchtova, H., Svobodova, Z., Kocour, M., Velišek, J. (2006): Evaluation of the Dressing Percentage of 3-year-old Experimental Scaly Crossbreds of the Common Carp (*Cyprinus carpio*, Linnaeus 1758) in Relation to Sex. Acta Vet., Brno, 75:123-132.

Buchtova, H., Svobodova, Z., Kocour, M., Velišek, J. (2006): Evaluation of growth and dressing out parameters of experimental scaly crossbreds in 3-year-old common carp (*Cyprinus carpio*, Linnaeus 1758). Aquaculture Research 37, 466-471 pp.

Bogut, I., Magovac, R., Sabo, D., Bodakoš, D., Galović, D., Arežina, M., Rajković, V. (2007): Cage fattening results of Common Carp (*Cyprinus carpio*) in hydroaccumulation Grabovo near Vukovar. *Krmiva* 49, Zagreb, 4, 207-214 pp.

Ćirković, M., Trbović, D., Ljubojević, D., Đorđević, V. (2011): Meat quality of fish farmed in polyculture in carp ponds in Republic of Serbia. *Tehnologija mesa*, vol. 52, br. 1, str. 106-121.

Gela, D., Linhart, O. (2000): Evaluation of slaughtering value of common carp from diallel crossing. *Czech Journal of Animal Science* 45, 53-58 pp.

Gross, R. (1997): Dressing percentage in market-size Common Carp: Effect of strain, year-class, sex, body size and shape. *Aquaculture sponsored symposium on the Carp*. Budapest, September 6-9, poster.

Ljubojević, D., Ćirković, M., Novakov, N., Babić, J., Lujić, J., Marković, T. (2012): Faktori koji utiču na randman šaranskih riba. *Tehnologija mesa*, vol. 53, br 1, str. 14-19.

Orajić, D., Zrnčić, S. (2009): Bolesti šarana-opasnosti u kaveznom uzgoju, Uzgoj slatkovodne ribe, stanje i perspective. *Hrvatska gospodarska komora. Zbornik radova*, 87-94 pp.

Lovell, R.T., Menghe, Li. (1992): Comparison of Feed Conversion, Dressing Yield and Muscle Composition for Second-and Third-Year Chanell Catfish. *The Progressive Fish Culturist* 54, 171-173 pp.

Ljubojević, D., Ćirković, M., Novakov, N., Babić, J., Lujić, J., Marković, T., (2012): Uticaj različitih čimbenika na randman komercijalno uzgajanih ciprinidnih vrsta riba na šaranskim ribnjacima u Srbiji. *Croatian Journal of Fisheries* 70, 89-97 pp.

Mihailović, P., Marković, Z. (2007): Projektovanje kaveznih sistema za gajenje riba. III Međunarodna konferencija Ribarstvo. *Zbornik radova*, 317-324 pp.

Safner, R., Treer, T., Aničić, I., Kolak, A. (2001): Dressing percentage of four croatian common carp (*Cyprinus carpio* L.) populations. *Ribarstvo* 59 (4), 131-141pp.

Safner, R., Treer, T., Aničić, I., Kolak, A., Lovrinov, M., (1997): The Assessment of Phenotypic Correlation for the Common Carp (*Cyprinus carpio*). *Dressing Percentage Agriculturae conspectus scientificus*, vol. 63, No 1-2, 79-86 pp.

Vallois D., (1995): Carp processing and market analysis: a case study in France. *Aquaculture*, 129, 475-478 pp.