COMPARATIVE SLAUGHTERING ANALYSIS OF TWO-SUMMER OLD SILVER CARP (HYPOPHTHALMICHTHYS MOLITRIX VAL.) REARED UNDER THE CONDITIONS OF INTEGRATED AND NON-INTEGRATED TECHNOLOGIES

СРАВНИТЕЛЕН АНАЛИЗ НА КЛАНИЧНИТЕ ХАРАКТЕРИСТИКИ НА ДВУЛЕТЕН БЯЛ ТОЛСТОЛОБ (HYPOPHTHALMICHTHYS MOLITRIX VAL.), ОТГЛЕЖДАН ПРИ ТРАДИЦИОННА И ИНТЕГРИРАНА С ПАТИЦИ ТЕХНОЛОГИИ

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ABSTRACT

A comparative slaughtering analysis has been carried out at the Institute of Fisheries and Aquaculture, Bulgaria upon two-summer old silver carp, reared in polyculture (H. molitrix 300 p-ces.ha^{-1} and C. carpio – 2000 p-ces.ha^{-1}) under the conditions of integrated with ducks (Peking ducks and mule ducks) and non-integrated technologies. The fish in all experimental ponds have grown well and no considerable difference has been observed between the separate variants as regards the final live weight. The integration has exercised a positive ($F=4.182$; $P<0.005$) effect upon the slaughtering output, however, this effect has not been preserved as regards the relative fillet share within the fish carcass ($F=0.096$; $P<0.05$).

Keywords: silver carp, integrated aquaculture, fish-and-duck farming, slaughtering analysis

РЕЗЮМЕ

В Института по рибарство и аквакултури, България е направен сравнителен кланичен анализ на двулетен бял толстолоб, отглеждан в поликултура (H. molitrix 300 бр.ha^{-1} и C. carpio - 2000 бр.ha^{-1}) в условия на интегрирана с патици (пекински и мюлари) и не интегрирана технологии. Рибите във всички експериментални басейни са нараствали добре, като няма значителна разлика между отделните варианти по отношение на крайната жива маса. Интеграцията е оказала положително ($F=4.182$; $P<0.005$) въздействие върху кланичния рандеман, но това влияние не се запазва по отношение на относителния дял на филето в трупа ($F=0.096$; $P>0.05$).

Ключови думи: бял толстолоб, интегрирана аквакултура, интеграция риба-патици, кланичен анализ

DETAILED ABSTRACT

Проучването е извършено в Института по рибарство и аквакултура – Пловдив, България. Бяха използвани угоителни шаранови басейни (три – интегрирана технология; два – традиционна (не интегрирана технология)) с площ от 1.3 до 4.1 dka. Поликултурата включваше двугодишен шаран (Cyprinus carpio L.) с посадка 2000 бр.ha^{-1} (1:1 люспест и огледален) и едногодишен бял толстолоб (Hypophthalmichthys molitrix Val.) с посадка 300 бр.ha^{-1}. В басейните беше внасян концентриран фураж (30% слънчогледов шрот, 70% пшеница) планиран само за шарана (4.5 kg за 1 kg прираст). Дневните дажби са определяни в съответствие с процентното месечно разпределение (април – 2%; май – 9%; юни – 20%; юли – 25%; август – 25%; септември – 18%; октомври – 1%). В рибовъдните басейни бяха поставяни за отглеждане патета от Пекинската порода (след 20-дневна възраст) (I оборот) и мюлари (след 30-дневна възраст) (II оборот). Патетата бяха хранени със смеска от пшеница (95%) и слънчогледов шрот (5%) без добавяне на минерални и биологично-активни вещества, като храната беше залагана на хранилките, монтирани под навесите на дигите на басейна. Патетата са отглеждани при осигуряване на денонощен достъп до басейна. Нивата на натовареност на басейните с патетата са изчислени по Николова (2006). Средната натовареност на интегрираните басейни Kd=2.498. За кланичния анализ, в края на вегетационния период от всеки експериментален басейн бяха взети по 5 толстолоба. За всяка риба бяха измерени (kg) живата маса; теглото на почистеното трупче с кожа и люспи (без перки, вътрешностите, глава); на кожата с люспите и подкожна мазнина; перките; главата без хрилете; хрилете; общото тегло на вътрешностите и на филето без кожа. Беше изчислено съотношението на отделните части на тялото. Кланичният рандеман беше изчислен като съотношение на почистеното трупче към живата маса на рибите, а относителният дял на филето - към теглото на почистеното трупче. За обработка на данните използвахме многофакторен дисперсионен анализ.

Рибите във всички експериментални басейни са нараствали добре. Ls-средна крайна жива маса съставлява 1.283 kg. Няма значителна разлика между отделните варианти по отношение на показателя ($F=0.606$; $P>0.05$). При рибите от експерименталните басейни почистеното трупче е било със средна маса 0.855 kg, при разлика по показателя между интегрирани и неинтегрирани басейни в 2% ($F=0.129$; $P>0.05$). С по-висок рандеман са били рибите от интегрирани басейни ($F=4.182$; $P<0.05$). Проучваните признаци не са оказали достоверно влияние върху абсолютната стойност и относителния дял на филето в трупчето на рибите от експерименталните басейни. Ls-средната маса на филето при толстолоба е 0.522 kg, като съставлява средно 69.4% от масата на почистеното трупче. Рибите от неинтегрирани басейни имаха с 4.5% по-тежко филе ($F=0.387$; $P>0.05$), но по отношение на относителния дял на филето в трупчето разликата практически няма ($F=0.096$; $P>0.05$).

INTRODUCTION

The integrated aquaculture, as well as the other sub-branches of agriculture have been indicated as important factors for increasing production stability [4]. The introduction of integrated aquaculture, however, is a complex process and the results obtained are not always one-directional [5]; [7].

Of all types of integrated aquaculture, that of fish-and-duck farming has been the most versatile one. The birds have a complex effect upon fish-pond ecosystem. They have a favorable effect upon plankton organism development, because of which the fish plankton-fagues and the silver carp most of all are very suitable to be included in this integrated system [11].

The growth and the development of the separate fish species included in the polyculture should be investigated under the concrete conditions of the integration scheme applied. The slaughtering characteristics of the fish reared refer to the five main characteristics determining their economical value [2]. Fish quality besides on genetic factors depends also on non-genetic interactions. So, Prikryl and Janecek [10] have traced the effect of the production intensification level upon the slaughtering output of the silver carp. The purpose of this investigation is to make a comparative slaughtering analysis of two-summer old silver carp (Hypophthalmichthys molitrix Val.) reared under conditions of ducks integrated and non-integrated technologies.

MATERIALS AND METHODS

The investigation has been done within “Technology for Integrated Rearing of Water-Swimming Birds and Fish in Warm Water Fish-Ponds Type” Project of the thematic schedule of the Institute of Fisheries and Aquaculture, Plovdiv, Bulgaria. Five fattening fish-ponds have been used (three - integrated technology; two – non-integrated (traditional) technology), with an area of 1.3 to 4.1 dka located in the experimental base of the Institute.

The fish has been reared in polyculture – two years old carp (Cyprinus carpio L.) with implantation of 2000 p-ces. ha^{-1} and one-year old silver carp (Hypophthalmichthys molitrix Val.), with implantation of 300 p-ces.ha^{-1}. The average single weight of the silver carp during pond stocking has been 0.214 kg. Two of the experimental fish-ponds (the integrated and the non-integrated ones) have been stocked with carp having an average weight of 0.478 kg and three fish-ponds (2 integrated and 1 non-integrated) with carp having an average weight of 0.340 kg. During the vegetation period, concentration fodder has been supplied to the fish-ponds (30% sunflower groats, 70% wheat) scheduled for carp only (4.5 kg per 1 kg growth rate). The daily rations have been determined according to the percent monthly distribution (April – 2%; May – 9%; June – 20%; July – 25%; August – 25%; September – 18%; October – 1%), the fish being fed once per day, five times per week.

From the stocking till the end of the fattening period, water physical and chemical analysis has been done once per week. The average seasonal indices characterizing water quality in the experimental fish-ponds have been within the technological norms for the fish species reared (temperature – 22.5^o C; pH – 8.2; oxygen dissolved in water – 10.2 mg.l^{-1}).

Pekin ducks (more than 20-days` age old) ($I^{th}$ turnover) and mule ducks (more than 30 days` age old) (II^{nd} turnover) have been transferred for rearing into the fish-ponds. The ducks have been fed on mixture of wheat (95%) and sun flower groats (5%) prepared in a farm, with no mineral and biologically active substances added to it. The ducks have been fed twice a day and the feed has been put on the feeding-troughs mounted under the shed upon the fish-pond dike. The ducks have been reared by ensuring an unlimited access to the fish-pond day and night. The levels of fish-ponds loading with ducks have been calculated after Nikolova [8]. The method suggests that for conducting the complex assessment of the effect of waterfowls on the fishpond it is advisable to use the "Coefficient of fishpond loading with ducklings" (Kd) which includes: sum of the rotations for the vegetation period; mean number of ducklings in the rotation; the duration of rotation in days; average live weight of the ducklings for the period of raising; duration of the vegetation period; coefficient about the time the ducklings spent in water, etc. The average loading (Kd) of the integrated fish-ponds has been 2.498.

For the purpose of the slaughtering analysis, at the end of the vegetation period, 5 silver carps have been taken from each experimental fish-pond. The following indices have been measured per each fish: the live weight (kg); the cleaned carcass weight, with skin and scales (without fins, viscera, and head); the skin with scales and hypodermic fats; the fins; the head without the gills; the gills; the total weight of the viscera, and the fish fillet without skin. The viscera weight included the blood and the body liquids [9]. The ratio of the separate body parts has been calculated. The slaughtering output has been calculated as the ratio of the cleaned fish carcass to the fish live weight, and the relative fish fillet share – to the cleaned fish carcass weight.

For the purpose of data processing we have used a multifactor dispersion analysis. The linear model had the following general view:

Yijklmn = μ + TCi + PAj + CVk + SXl + BWm + eijmn, where:

Yijklmn – the slaughtering index investigated of the n^{th} specimen; μ - the general average constant; TCi; PAj, CBk; SXl; BWm – the fixed effects respectively of the i^{th} technology of rearing in the fish-pond (2); the j^{th} area of the fish-pond (2); the m^{th} initial body weight of the fish

Table 1:Results of the slaughter analysis of fishes in the experimental ponds, kg
Таблица 1: Резултати от кланичен анализ на рибите в експерименталните басейни, kg

Indices	Integrated ponds		Non-integrated ponds		Total		
	LS	±Se	LS	±Se	LS	±Se	CV
Live weight	1.250	0.0595	1.316	0.0595	1.283	0.0421	14.7
Head (without gills)	0.229	0.0154	0.269	0.0154	0.249	0.0109	19.4
Gills	0.034	0.0019	0.037	0.0019	0.035	0.0014	17.1
Fins	0.033	0.0021	0.036	0.0021	0.035	0.0015	18.7
Skin with scales	0.108	0.0089	0.097	0.0089	0.102	0.0063	28.3
Intestines (total)	0.110	0.0061	0.110	0.0061	0.110	0.0043	17.7
Carcass weight	0.845	0.0394	0.865	0.0394	0.855	0.0279	14.6
Fillet (without skin)	0.510	0.0266	0.533	0.0266	0.522	0.0188	16.2

Table 2: Relative share of the separate parts of the fish body, %
Таблица 2: Относителен дял на отделните части на тялото на рибите, %

Indices	Integrated ponds		Non-integrated ponds		Total		
	LS	±Se	LS	±Se	LS	±Se	CV
% of live weight							
Head (without gills)	18.31	0.57	20.26	0.57	19.29	0.40	9.21
Gills	2.75	0.11	2.78	0.11	2.77	0.08	12.57
Fins	2.67	0.14	2.74	0.14	2.71	0.10	16.06
Skin with scales	8.59	0.55	7.47	0.55	8.03	0.39	22.30
Intestines (total)	8.71	0.25	8.39	0.25	8.55	0.18	9.31
Carcass weight	67.57	0.59	65.85	0.59	66.71	0.42	2.83
% of carcass weight							
Fillet (without skin)	69.61	1.18	69.09	1.18	69.35	0.84	5.40

(2); e (..) – the residual variance.

RESULTS AND DISCUSSION

The results obtained in the investigation have been presented in Table 1 and Table 2. In general, the fish in all experimental fish-ponds have grown well. Ls –the average live weight has amounted to 1.283 kg. There is no significant difference between the separate variants, as regards the final live weight of fish ($F=0.606$; $P>0.05$). Ls – the average live weight of the head without the gills of the silver carp has been 0.249 kg, and it has amounted to 19% of the fish live weight. The values obtained have approached the maximum relative share levels of the silver carp head determined during investigations carried out by Prikryl and Janecek [10]. As regards silver carp from the non-integrated fish-ponds, the relative share of the head has been by 11% higher ($P<0.05$) in comparison with that from the integrated fish-ponds. The significant effect of the integration factor upon the relative share of the head has been connected with its significant effect ($F=5.859$; $P<0.05$) upon the relative share of the fish carcass.

The gills and the fins have had practically identical weight and have occupied a similar share of the fish live weight (2.7%), the gills amounting to about 12% of the head weight. The fish from the integrated and non-integrated fish-ponds have had similar relative share levels of the external, non-edible parts of the body. There is no difference as regards viscera absolute value, either. The difference as regards their relative share has amounted to 3.8% and has been unauthentic. None of the factors investigated has had an authentic effect upon this index.

The fish skin belongs to the waste products, but nowadays there has been a marked interest in it as a raw material for the production of different products. Ls –the average skin weight with scales and hypodermic fats has been 0.102 kg. The integrated fish-ponds fish have had heavier skin (10%), the difference being unauthentic. The relative skin share has amounted to about 8%.

As far as the slaughtering fish output is concerned, the data stated by some authors can be considerably different [1]. The reasons for this are the differences concerning the age, the sex, the origin, the rearing technologies, as well as the differences in the methodologies for determining the slaughtering indices applied. To the edible fish body parts we can also count the head without the gills – “the consumable output” [12]. The fish output calculated in that way in our experiment has been increased by about 20%. Berka [1] has noted that utilization of the edible body parts (the meat from the head, heart, liver, spleen and kidneys) has been rather problematic from technological and commercial point of view. That is why, the slaughtering fish output most often has been determined as the relative share of cleaned fish carcass without head.

Concerning the fish from the experimental fish-ponds, the cleaned fish carcass has had an average weight of 0.855 kg, and the difference between the integrated and non-integrated fish-ponds index has been 2% only ($F=1.129$; $P>0.05$).

The average slaughtering output value has been 66.7%. The data obtained by us have been similar to those established by Hajinikolova [3] as regards the bighead carp and have been higher than the values obtained for the silver carp by Berka [1]. Prikryl and Janecek [10], in their experiments have established higher output levels of silver carp – 69.1%, but the fish used by them have been older.

The tendencies, as regards the slaughtering indices in this investigation have been similar to those established by us of carp reared in integrated and in non-integrated fish-ponds [6]. The fish from the integrated fish-ponds have had a higher output in our experiment and the difference has been authentic ($F=4.182$; $P<0.05$). Besides the slaughtering output, a significant characteristics has been the relative fillet share in the cleaned fish carcass. The characteristics investigated have not got authentic effect upon the absolute value and upon the relative fillet share in the cleaned fish carcass from the experimental fish-ponds. Ls – the average fillet weight of the silver carp has been 0.522 kg, which amounts to 69.4% of the cleaned fish carcass. The fish from the non-integrated fish-ponds have had by 4.5% higher fillet ($F=0.387$; $P>0.05$) but as regards the relative fillet share in the cleaned fish carcass, practically there has been no difference – 0.7% ($F=0.096$; $P>0.05$). Consequently, the higher output of the fish from the integrated fish-ponds has been formed by the higher skin with the hypodermic fats. We should note, however, that regardless of the more considerable integration effect established ($F=2.065$) upon the relative fish carcass share together with the skin and the hypodermic fats, the effect has been unauthentic.

CONCLUSION

Under the conditions of this experiment, the two summer old silver carp has grown very well, but there has been no considerable difference between the separate technological variants as regards the final fish live weight. The integration has had a positive effect ($F=4.182$; $P<0.05$) effect upon the slaughtering output, but this effect has not been preserved as regards the relative fillet share in the cleaned fish carcass ($F=0.096$; $P>0.05$).

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