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The effects of dietary betaine on the growth performance and carcass synthesis of caspian roach (*Rutilus rutiluscaspicus*) fingerlings

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A B S T R A C T

This study was carried out to determine the effects of betaine on the growth performance and carcass synthesis of Caspian Roach (*Rutilus rutilus caspicus*) fingerlings. Fish with mean weight about 1.91±0.01g after adaptation were divided to 2 treatment groups (0.5 and 1% of diet) and control (0%). After 8 weeks feeding with betaine added diet, data was analyzed by excel 2010 and Spss 18.Added betaine had anincreasing effect on final weight, weight gain (BWI), and a decreasing effect on FCR, but not significantly. Food intake increased significantly as added betaine increased ($p<0.05$). Betaine is known as a flavor attractant and improves growth factors of Caspian Roach (*Rutilus rutilus caspicus*) fingerlings.

1. Introduction

Betaine is naturally occurring tertiary amine present in most living organisms and is formed by the oxidation of choline (Barak et al., 1996). Betaine was at first introduced to the feed industry such a replacement for methionine and choline in fish and poultry diets, where it is supposed to act both as an organic osmoprotectant and as a methyl supporter (Kidd et al., 1997). Additionally, betaine increases the synthesis of methylated compounds including carnitine and phospholipids (Eklund et al., 2005). Consequently, betaine via its role in phosphatidylcholine synthesis and in FA (Fatty Acid) oxidation can be integrally involved in lipid metabolism, because carnitine is needed for long-chain FAs transporting into mitochondria, in which they are devalued via β-oxidation (Carter et al., 1995). Moreover, betaine has been accepted as a non-alcoholic steatosis (Neuschwander-

Tetri., 2001) and a hepatoprotective agent against alcoholic (Barak et al., 1997). Therefore, betaine can be used to increase the resistance to imbalance between lipid synthesis (increased) and secretion (reduced) because of its hepatoprotective effect.Dietary betaine decreased backfat thickness with no affecting growth performance, but somestudies have variable outputs (Cadogan et al. 1993). Sales (2011) presented conclusive this results that betaine supplementation of diets for finishing pigs decreased carcass characteristics typically used as indicators of carcass fatness.Although betaine compounds did not increase the nutritional value of formulated diet but they are useful to increase the food palatability and acceptance and enhance the consumption of poor quality food (Fekrandish et al., 2005).In some researches, betaine supplementation had minimal or no effects on growth performance and carcass traits (e.g., Matthews et al., 1998; Øverland et al., 1999), whereas in other studies, betaine supplementation improved them (e.g., Matthews et al., 2001; Siljander-Rasiet al., 2003).Guangbingand Daivis (2005) noticed that because the price of methionine is higher than choline and betaine, it is important to use methionine for protein synthesis and to use choline or betaineas methyl donor in metabolism. Therefore, a better understanding of the interrelationship among methionine, choline, and betaine may no only improve fish growth performance but also reduce the cost of feed.Our study aims to examine the effect of betaine on the Roach juveniles to improve growth factors and flesh quality.

2. Materials and methods

Fish with mean weight of 1.91±0.01 g and mean length of 6.21±0.07 cm, were provided from Bony fish Propagation and Rearing Center of Sijwal, Gorgan.After adaptation (2 weeks), fish were divided to 2 treatment groups and one control. Each tank was containing100 fish.Fish were maintained in piped water. Water factors during the experiment were stainable (T: 23^{0C}, Salinity: 0.5 ppt, Do>6 mg/l, pH: 7.7-8, Total hardness: 180 mg/l). Chemophysical parameters were monitored during the experiment period. Fish were fed three percent of body weight, 2 times a day. Meal formula is shown in Table 1.

Table1
Meal formula during the experiment.

Material	Percent%	Material	Percent%
Fish meal	29	Minerals	1
Fish oil	5	Vitamin supplement	1
Soy flour	32.9	Methionine	1
Phytase	0.1	Lysine	1
Wheat flour	14	D.C.P	1
Barely flour	14		

After the breeding period (60 days) to determine the composition of the carcasses of fish after the evacuation of the entire contents of the stomachs of fish from each group 10 fish were randomly selected and then weighed, minced and mixed for analysis of the carcasses to the lab for Measuring body composition including protein, fat, ash and moisture content in different treatments in order by Micro-kjeldahl apparatus, soxhlet fat meter, oven (105 $^{\circ C}$) and were transferred to an electric furnace(A.O.A.C).. SGR(Specific Growth Rate)(Larid and Needlham, 1988), VW%(Velocity of growth body weight)(De Silva and Anderson, 1995), FCR(Food Conversion Rate)(Hevroy et al, 2005), and FCE(Food Conversion Efficiency)(Hevroy et al, 2005) was calculated. All values were means±standard error of the mean (S.E.M.). All statistical tests were performed using One-way ANOVA,SPSS (18).

SGR: 100*(Ln W_2- W_1)/experiment duration
VW: 100*[2(W_2-W_1)/ experiment duration (W_2+W_1)]
FCR: Food intake (g)/weight gain (g)
FCE: Weight gain (g)/food intake

3. Results

Growth and carcasses synthesis of *Rutilus rutilus caspicus*

No mortality was seen during the breeding period. The growth factors of fishes receiving the 0, 0.5, and 1 % betaine are shown on Table 3.After 60 days, final weight, and weight gain were higher in groups which were fed with the betaine-supplemented diet as compared with the control group but not significant (one-way ANOVA, Duncan Multiple Range test; Pb0.05). Food intake between betaine- treated groups was significantly higher than control group ($p<0.05$). Except FCR, other growth parameters showed no significant difference among treatments (one-way ANOVA, Duncan), but showed better result in 1% treatment than both control and 0.5% betaine groups.

Table3
The growth factors of *Rutilus rutilus* fingerlings during the experiment.

Treatment / Parameter	Control	0.5% Betaine	1 % Betaine
Initial weight	1.76 ± 0.03^{a}	1.74 ± 0.05^{a}	1.77 ± 0.06^{a}
Final weight	4.36 ± 0.15^{a}	4.49 ± 0.18^{a}	4.59 ± 0.11^{a}
BWI	2.60 ± 0.12^{a}	2.74 ± 0.21^{a}	2.81 ± 0.14^{a}
Food Intake	182.43 ± 3.68^{a}	196.30 ± 0.18^{b}	204.53 ± 1.58^{c}
SGR%	1.51 ± 0.28^{a}	1.57 ± 0.10^{a}	1.58 ± 0.07^{a}
VW%	53.08 ± 4.00^{a}	57.13 ± 5.70^{a}	59.76 ± 3.66^{a}
FCR%	1.42 ± 0.07^{a}	1.40 ± 0.12^{a}	1.37 ± 0.07^{a}
FCE%	0.70 ± 0.03^{a}	0.71 ± 0.06^{a}	0.72 ± 0.04^{a}

The composition of Roach's bodyis shown in Table 4.

Table4
Body composition of *Rutilus rutilus* fingerlings in feeding treatments.

Treatment / Parameter	Control	0.5% Betaine	1 % Betaine
Moisture%	72.68±0.35	72.34±0.25	71.56±0.08
Dray matter%	27.31±0.35	27.65±0.25	28.43±0.08
Crude protein%	63.55±0.51	64.90±0.09	65.93±5.74
Ash%	11.00±0.14	10.27±0.46	10.48±0.61
Lipid%	29.53±0.18	25.76±0.09	20.40±0.42

Values with different superscripts are significantly different from each other. Significance level is defined as $p< 0.05$.

Carcass synthesis(whole of fish) of *Rutilus rutilus* fingerlings is shown in Table 5. Crude protein had increased as the dosage of Betaine increased, and the differences between them was significant ($p<0.05$).

Table5
Body composition of *Rutilus rutilus* fingerlings in feeding treatments.

Treatment / Parameter	Control	0.5% Betaine	1 % Betaine
Moisture%	75.40 ± 0.33^{a}	75.26 ± 0.43^{b}	75.49 ± 0.05^{ab}
Dray matter%	24.59 ± 0.33^{a}	24.73 ± 0.43^{b}	24.50 ± 0.05^{a}
Crude protein%	76.99 ± 0.01^{a}	76.90 ± 0.09^{a}	77.36 ± 0.36^{ab}
Ash%	9.43 ± 0.18^{a}	9.44 ± 0.16^{a}	9.14 ± 0.11^{b}
Lipid%	13.59±0.10	13.43±0.00	16.50±0.01

Values with different superscripts are significantly different from each other. Significance level is defined as $p< 0.05$.

4. Discussion

Betaine is an amino acid which is non-toxic and is found in nature widely (Kettunen et al., 2001) acting three major metabolic functions, a methyl donor, providing methyl groups for essential biochemical reactions(Scott, 1986),as an osmolyte, which allows accumulation of a sufficient muscle betaine reserve so as to reduce the consequences of osmotic stress in fish (Virtanen et al., 1989; Clarke et al.,1994; Castro et al., 1998); andto stimulate feeding intake for several fish and crustacean species (Virtanen et al. 1994; Coman et al. 1996; Knights 1996; Harpaz 1997; Papatryphon and Soares 2000). As our result showed, added betaine could increase growth indices as betaine increased in diet. Kasper *et al.* (2002) found that the dietary betaine can spare the entire choline requirement of juvenile tilapia fed a chemically purified diet. These studies strongly support our conclusion that betaine can improves growth in poach fingerlings. In addition to functioning as a methyl donor, betaine is known as a flavor attractant as our experiment showed that food intake in 0.5 and 1% betaine-supplemented diet was significantly higher than control group as Harpaz, (1997) reported that addition of betaine to diets for prawns, *Macrobrachiumrosenbergii*resulted in increased feed consumption and growth rate. Moreover, acting as a methyl donor, betaine can enhance the synthesis of methylated compounds, such as carnitine and phospholipids (Carter et al., 1995;Chiang et al., 1996).ZakipourRahimabadi et al., (2011) demonstrated that the addition of betaine in different levels to trout starter food (biomar) improved the growth performance and best results found in treatment containing 2 % betaine + biomar and in the other case Sadeghi (2004) showed that betaine improved the growth performance in rainbow trout at 3 % level . Polat and Beklevik (1998) noticed on salmon at 1.5 and 2.0 % level, and on yearling Chinook salmon (Clarke et al., 1994) better result on growth performance were observed compared to the other treatments and control group. In contrast, several other examines reported that betaine did not have significant effect on the growth performance in *Orechromisaureus*(Genc et al., 2006).It is believed that betaine hasa response as a palatability enhancer such a methyl donor and osmoprotectant. On the other hand, betaine has been known as an osmoprotectant in salmon and trout (Virtanen et al., 1989, 1994; Clarke et al., 1994; Castro et al., 1998) andit could also have a positive effect on striped bass. However, in the salmonids only during seawater adaptation and thereafter, were evident whereas no significant effects were observed during the freshwater stage.Kasumyan and Doving (2003) demonstrated that the effect of betaine-supplemented diet on growth prrformance in some fish has just observed in food transition period, when increased palatability of food could be an important factor for increasing appetite. Highest survival rate was found in fingerlings fed biomar without betaine and showed that addition of betaine had not effect on survival rate.

References

A.O.A.C. (Association of Official Analytical Chemists)., 2005. Official Methods of Analysis, 18th edition, M..D., Gaithersburg, USA.

Barak, A.J., Beckenhauer, H.C., Badakhsh, S., Tuma, D.J., 1997. The effect of betaine in reversing alcoholic steatosis.Alcohol.Clin. Exp. Res., Vol.21. Pp 1100–1102.

Barak, A.J., Beckenhauer, H.C., Tuma, D.J., 1996. Betaine effects on hepatic methionine metabolism elicited by short-term ethanol feeding.Vol. 13. Pp 483–486.

Cadogan, D.J., Campbell, R.G., Harrison, D., Edwards, A.C., 1993. The effects of betaine on the growth performance and carcass characteristics of female pigs. In: Batterham, E.S., (Ed.), Manipulating Pig Production. Australasian Pig Science Association, Attwood, Victoria, Australia, Pp 219.

Carter, A.L., Abney, T.O., Lapp, D.F., 1995. Biosynthesis and metabolism of carnitine. J. Child Neurol.Vol. 10. Pp S3–S7.

Castro, H., J. Battaglia, and Virtanen, E., 1998. Effect of FinnStim on growth and sea water adaptation of coho salmon. Aquaculture.Vol. 168.Pp423–429.

Chiang, P.K., Gordon, R.K., Tal, J., Zeng, G.C., Doctor, B.P., Pardhasaradhi, K., McCann, P.P., 1996. S-adenosylmethionine and methylation.FASEB J.Vol. 10. Pp 471–480.

Clarke, W. C., Virtanen, E., Blackburn,J.,Higgis, D. A., 1994. Effect of dietary betaine/amino acid additive on growth and seawater adaptability in yearling chinook salmon. Aquaculture Vol. 121.Pp137–145.

Coman, G. J., Sarac, H. Z., Fielder, D., Thorne, M., 1996. Evaluation of crystalline amino acids, betaine and AMP as food attractants of the giant tiger prawn (*Penaeus monodon*). Comparative Biochemistry and Physiology.Vol. 113A. Pp247–253.

De Silva, S.S., Anderson, T.A., 1995. The effect of ration on growth ratio.Fish Nutrition in Aquaculture. Chapman, London. UK.

Eklund, M., Bauer, E., Wamatu, J., Mosenthin, R., 2005.Potential nutritional and physiological functions of betaine in livestock.Nutr.Res.,Rev.Vol. 18. Pp 31–48.

Fekrandish, H., Abediankenari, A. M., Matinfar, A., Dehqhani, A., 2005. Influence of betaine and methionine in the diet for stimulating food intake of Indian white shrimp (*Fenneropenaeusindicus*). Pajouhesh and Sazandegi. Vol. 73.Pp 136-147.

Genc, M.A., Tekeliogluu, N., Yilmaz, E., Hunt, A.O., Yanar, Y., 2006. Effect of dietary betaine on growth performance and body composition of *Orechromisaureus*reared in fresh and sea water: a comparative study. Journal of Animal and Veterinary Advances. Vol. 12.Pp 1185-1188.

Guangbing, W., Daivis, D. A., 2005. InterrelationshipAmong Methionine, Choline, and Betainein Channel Catfish *Ictaluruspunctatus*. Journalof the worldAquaculture Society.Vol.36(3).Pp 337-345.

Harpaz, S., 1997.Enhancement of growth in juvenile freshwater prawns, *Macrobrachiumrosenbergii*, through the use of a chemoattractant.Aquaculture.Vol. 156.Pp225–231.

Hevroy, E.M., Espe, M., Waagbo, R., Sandness, K., Rund, M., Hemre, G.I., 2005. Nutrition utilization in atlantic salmon (*Salmosalar* L) fed increased level of fish protein hydrolysate during a period of fast growth. Aquacul.Nutr.Vol. 11.Pp 301-313.

Kasper, C.S., White, M.R., Brown.P.B., 2002. Betaine can replace choline in diets for juvenile Nile Tilapia, *Oreochromis niloticus*. Aquaculture.Vol. 205.Pp119–126.

Kasumyan, A.O., Doving, K. B., 2003. Taste preferences in fishes. Fish and Fisheries. Vol. 4.Pp 289-347.

Kettunen, H., Peuranen, S., Tiihonen, K., Saarinen, M., 2001. Intestinal uptake of betaine in vitro and distribution of methyl groups from betaine, choline and methionine in the body of broiler chicks. Comparative Biochemistry and Physiology.Vol. 128A.Pp269–278.

Kidd, M.T., Ferket, P.R., Garlich, J.D., 1997. Nutritional and osmoregulation functions of betaine.World Poult. Sci. J. Vol. 53. Pp 125–139.

Knights, B., 1996. Studies of feeding stimulation in young eels, *Anguilla anguilla*L., before and after first-feeding using a novel rapid-screening method. Aquaculture Research.Vol. 27.Pp 379–385.

Larid, L.M., Needham, M., 1988. Growth, Nutrition and Feeding, Salmon and Trout Farming. England, Ellis Horwood Limited. London, UK.

Matthews, J.O., Southern, L.L., Higbie, A.D., Persica, M.A., Bidner, T.D., 2001. Effects of betaine on growth, carcass characteristics, pork quality, and plasma metabolites of finishing pigs. J. Anim. Sci. Vol. 79. Pp 722–728.

Matthews, J.O., Southern, L.L., Pontif, J.E., Higbie, A.D., Bidner, T.D., 1998. Interactive effects of betaine, crude protein, and net energy in finishing pigs. J. Anim. Sci.Vol. 76. Pp2444 -2455.

Neuschwander-Tetri, B.A., 2001. Betaine: an old therapy for a new scourge. Am. J. Gastroenterol.Vol. 96. Pp 2534–2536.

Overland, M., Rørvik, K.A., Skrede, A., 1999.Effect of trimethylamine oxide and betaine in swine diets on growth performanance, carcass characteristic, nutrient digestibility, and sensory quality of pork. J. Anim. Sci.Vol. 77. Pp 2143–2153.

Papatryphon, E., Soares. J. H., 2000. Identification of feeding stimulants for striped bass, Moronesaxatilis. Aquaculutre.Vol. 185.Pp339–352.

Polat, A., Beklevik, G., 1998. The importance of betaine and some attractive substances as fish feed additives. Feed Manufacturing in the Mediterranean Region Recent Advances in Research and Technology, Spain. Pp 217-220.

Sadeqhi, H., 2004. Effect of different levels of betaine instead of choline kolorid in the diet for Comparison of growth performance, body composition and survival rate of *(oncorhynchusmykiss*).PhD thesis in Veterinary Public. Tehran University Faculty of Veterinary Medicine.Pp 15-29.

Sales, J., 2011.A meta-analysis of the effects of dietary betaine supplementation on finishing performance and carcass characteristics of pigs.Animal Feed Science and Technology.Vol. 165.Pp 68–78.

Scott, M. L., 1986. Nutrition of humans and selected animal species.John Wiley and Sons, New York, New York, USA.

Siljander-Rasi, H., Peuranen, S., Tiihonen, K., Virtanen, E., Kettunen, H., Alaviuhkola, T., Simmins, P.H., 2003.Effect of ofequi-molar dietary betaine and choline addition on performance, carcass quality and physiological parameters of pigs. Anim. Sci.Vol.76. Pp 55–62.

Virtanen, E., Junnila,M., Soivio.A., 1989. Effects of food containing betaine/amino acid additive on the osmotic adaptation of young Atlantic salmon, *Salmosalar*L. Aquacultur.Vol. 83.Pp109–122.

Zakipour Rahimabadi, E., Akbari. M., Arshadi. A., Effatpanah E., 2011. Effect of different levels of dietary Betaine on growth performance, food efficiency and survival rate of pike perch (*Sander lucioperca*) fingerlings.Iranian Journal of Fisheries Sciences. Vol. 4.Pp 902-910.