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SHORT COMMUNICATION

Hot pepper (Capsicum sp.) oil and its effects on growth performance and blood parameters in rainbow trout (Oncorhynchus mykiss)

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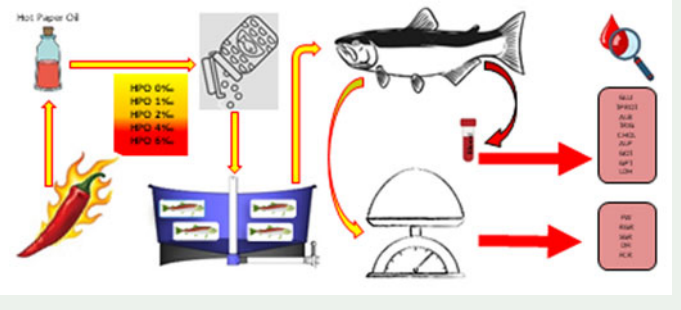
ABSTRACT

The authors studied the effect of hot pepper (*capsicum* sp.) oil on the growth performance and blood parameters in rainbow trout fed. Hot pepper oil was added to rainbow trout feeds at the rates of HPO 0‰ (0 mg/kg) (control), HPO 1‰ (1 mg/kg), HPO 2‰ (2 mg/kg), HPO 4‰ (4 mg/kg) and HPO 6‰ (6 mg/kg), and the fish were fed with experimental feeds for 60 days. The group fed with HPO 4‰ showed the highest percentage growth rate and the lowest feed conversion rate. Our results showed the significant differences serum biochemical parameters, a decrease of serum liver enzymes, glucose, cholesterol and triglyceride levels and an increase of total protein and albumin levels compared with the control. The use of HPO 1‰ in rainbow trout showed a positively affects the growth performance, haematological and serum biochemical parameters.



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Capsicum; GC/MS; haematology; natural product; *Oncorhynchus mykiss*; serum biochemistry

1. Introduction

Aquaculture is a rapidly developing method of animal protein production that can meet the growing need of nutrients without occupying terrestrial areas (FAO 2016).

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Table 1. Volatile components of hot pepper oil.

No	Analyte	Concentration (%)	*m/z*[a]	Identification method [b]
1	Palmitic Acid	1.57	43,73,60	MS
2	Oleic Acid	12.22	41,55,43	MS
3	2-methyltetracosane	1.31	57,71,43	MS
4	Erucic Acid	3.71	41,55,98	MS
5	Stearic Acid	14.93	55,69,83	MS
6	ɤ-Tocopherol	7.24	151,416,191	MS
7	α-Tocopherol	4.44	165,430,207	MS
8	α-Sitostrerol	3.44	285,328,286	MS
9	Campesterol	8.17	43,55,57	MS
10	β-Sitostrerol	16.38	43,55,107	MS
11	(3Z,13Z)-2-methyloctadeca-3,13-dien-1-ol	5.83	55,41,43	MS
12	Linoleic acid	1.38	67,81,95	MS

Some authors have showed how certain experimental procedures with additive feed can influence gastrointestinal morphological integrity in fish (Alesci et al. 2014, 2015; Lo Cascio et al. 2017). The use of immunostimulants derived from herbal products as a feed additive, particularly in recent years, can improve the innate defenses of fish and increase resistance to pathogens during periods of high stress, such as grading, reproduction, vaccination, seasonal transitions and transfer between the systems (Aramli et al. 2015). Since ancient times, hot peppers have been used as a food additive to preserve food and attract consumers' interest with its colour. Although it is traditionally used in the form of powder (paprika), with the development of technology, it has recently begun to be used in the form of oleoresin and pepper oil (Hornero-Méndez et al. 2000). Because of β-carotene and other carotenoids, which act as pro-vitamin A, in its content, hot pepper can be beneficial in scavenging free radicals produced by metabolic processes (Matsufuji et al. 1998). Studies have shown that capsicum is one of the plants with high antioxidant effects (Ou et al. 2002).

Therefore, the study was carried out to demonstrate the effect of addition of hot pepper oil, which is a commercial product obtained from hot peppers with known antioxidant effects, to rainbow trout feeds at different concentrations on the growth performance and blood parameters.

2. Experimental

In supplementary materials you can see in experimental part.

3. Results and discussion

The identifiable components and their quantities in GC/MS analysis of hot pepper oil after comparison of peaks with Wiley MS (W9N11 MS) library are presented in Table 1.

Significant differences were observed in final weight measurements between all groups ($P < 0.05$) (Table 2). FW, RGR and SGR rates in all the foods containing hot pepper oil were observed to be significantly higher than those of the control group ($P < 0.05$). According to the inter-group DFI calculations, the daily feed consumption of all of the trial groups was significantly higher than that of the control group ($P < 0.05$).

The effects of hot pepper oil at different concentrations on serum biochemistry parameters in rainbow trout are presented in Table 3.

Table 2. Growth performance in fish fed with feeds supplemented with hot pepper oil for 60 days.

	Treatment*					
Parameters	HPO 0‰	HPO 1‰	HPO 2‰	HPO 4‰	HPO 6‰	*P* value
IW (g)	7.20 ± 0.57	7.15 ± 0.04	7.18 ± 0.02	7.18 ± 0.04	7.25 ± 0.08	0.274
FW (g)	18.06 ± 0.41^{c}	25.83 ± 0.62^{a}	24.94 ± 0.30^{a}	19.45 ± 0.62^{b}	19.91 ± 0.27^{b}	<0.001
RGR (%)	150.60 ± 8.32^{c}	261.72 ± 8.32^{a}	247.32 ± 3.15^{a}	170.95 ± 10.03^{b}	174.63 ± 4.44^{b}	<0.001
SGR(%/day)	18.09 ± 0.62^{c}	31.18 ± 1.02^{a}	29.60 ± 0.47^{a}	20.45 ± 1.10^{b}	21.10 ± 0.44^{b}	<0.001
DFI(g/day)	0.20 ± 0.01^{b}	0.31 ± 0.01^{a}	0.30 ± 0.01^{a}	0.31 ± 0.02^{a}	0.31 ± 0.01^{a}	<0.001
FCR	1.09 ± 0.04^{b}	1.01 ± 0.06^{b}	0.94 ± 0.03^{b}	1.53 ± 0.15^{a}	1.47 ± 0.02^{a}	<0.001

Note: IW, initial weight; FW, final weight; RGR, relative growth rate; SRG, specific growth weight; DFI, Daily feed intake; FCR, feed conservation ratio. Means without the same alphabetical characters within the same parameters represent statistical differences ($P < 0.001$).
*Values represent mean ± standard deviation of three replicate tanks.

Table 3. Comparison of haematological and serum biochemistry parameters between the groups.

	Treatment*					
Parameters	HPO 0‰	HPO 1‰	HPO 2‰	HPO 4‰	HPO 6‰	*P* value
GLU (mgdL^{-1})	94.87 ± 16.97^{b}	49.55 ± 5.65^{d}	42.00 ± 4.87^{d}	75.78 ± 7.83^{c}	111.02 ± 7.59^{a}	<0.001
TPROT (gdL^{-1})	6.89 ± 1.28^{bc}	9.71 ± 0.87^{a}	8.03 ± 1.38^{b}	6.59 ± 0.77^{cd}	5.53 ± 1.54^{d}	<0.001
ALB (gdL^{-1})	0.47 ± 0.06^{b}	0.71 ± 0.10^{a}	0.67 ± 0.14^{a}	0.75 ± 0.10^{a}	0.67 ± 0.16^{a}	<0.001
TRIG (mgdL^{-1})	72.14 ± 13.68^{a}	64.07 ± 7.80^{ab}	67.87 ± 9.20^{ab}	63.29 ± 13.90^{ab}	55.83 ± 20.16^{b}	0.026
CHOL (mgdL^{-1})	148.77 ± 27.60^{ab}	119.63 ± 8.42^{c}	128.38 ± 35.56^{bc}	161.89 ± 32.60^{a}	157.63 ± 21.08^{a}	<0.001
GOT (U/L)	101.37 ± 12.27^{b}	90.63 ± 6.55^{c}	92.67 ± 8.97^{c}	93.14 ± 7.77^{bc}	112.77 ± 3.91^{a}	<0.001
GPT (U/L)	17.61 ± 2.21^{b}	11.41 ± 3.57^{d}	13.85 ± 2.31^{c}	19.72 ± 1.95^{ab}	20.87 ± 1.20^{a}	<0.001
ALP (U/L)	86.49 ± 12.98^{ab}	66.32 ± 15.83^{c}	75.85 ± 12.06^{bc}	88.11 ± 4.69^{a}	94.15 ± 3.96^{a}	0.107
LDH (U/L)	65.29 ± 22.45^{c}	69.16 ± 22.54^{c}	78.40 ± 26.69^{bc}	94.21 ± 5.21^{ab}	102.57 ± 3.25^{a}	0.012

Note: GLU, glucose; TPROT, total protein; ALB, albumine; TRIG, triglycerides; CHOL, total cholesterol; GOT, glutamic oxaloacetic transaminas*; GPT,* glutamic pyruvic transaminase; *ALP, Alkaline phosphatase*; *LDH*, lactate dehydrogenase. Means without the same alphabetical characters within the same parameters represent statistical differences ($P < 0.001$).
*Values represent mean ± standard deviation of nine fish per treatment.

Serum glucose levels were found to be significantly reduced in the groups containing hot pepper oil up to 4‰ compared with that in the control group ($P < 0.05$). Addition of hot pepper oil to the feeds significantly changed serum protein levels compared with the control group. The use of hot pepper oil at a rate of 1‰ significantly increased the TPROT level compared with the control group, and the ALB level in all the trial groups was significantly higher than in the control group ($P < 0.05$). The TRIG and CHOL levels showed changes from the control group depending on the amount of hot pepper oil in the feed. It was observed that the addition of hot pepper oil to a certain amount significantly reduced serum GOT, GPT and ALP levels compared with the control group ($P < 0.05$), and addition up to a rate of 2‰ had no significant difference in terms of LDH level compared with the control group ($P > 0.05$).

The volatile components vary depending on the pepper variety from which the product is extracted and the extraction process (Forero et al. 2009). In this study, 1.57% palmitic (C16:0), 14.93% stearic (C18:0), 12.22% oleic (C18:1) and 1.38% linoleic (C18:2) acid were detected in the composition of the hot pepper oil. Differences have been observed in the amount and fatty acid composition of oils obtained from hot pepper seeds grown in different regions (Pérez-Gálvez et al. 1999). The balanced use of vegetable oils in fish feeds has significant effects (Kalogeropoulos et al. 1993) or

not (Hematzadeh and Ali Jalali 2017) on the growth performance of fish. This may be due to the fact that vegetable oils added to feeds regulate the acidity of feed oils and increase the growth performance in fish (Glencross 2009). The studies have reported that serum GLU is increased with increasing stress level under unfavourable conditions (Carthy et al. 1971). Hot pepper oil significantly reduced serum glucose level in fish except those in the group that received 6‰ hot pepper oil. In our study, the fish fed with HPO 1‰ feeds were observed to have the highest serum TPROT and ALB levels. In fish, ALB is considered as alpha plasma proteins. Because they contain the necessary materials for metabolism such as free fatty acids and Fe, their increase in plasma indicates that immunity of fish is strengthened (Wiegertjes et al. 1996). In the analysis of serum TRIG and CHOL levels in this study, it was observed that the addition of hot pepper up to a certain concentration reduces the levels of these parameters in fish (Heinemann et al. 1991). This is considered to be caused by campesterol and sitosterols, which are phytosterols contained in hot pepper oil. The increase in serum GOT, GPT, ALP and LDH levels is an indicator of the occurrence of adverse events in the liver (Oboh and Rocha 2007). In this study, these enzymes were at the lowest level in fish fed with HPO 1‰ feeds.

4. Conclusion

Considering the differences in blood parameters and growth performance in rainbow trout fed with feeds containing hot pepper oil at different concentrations, it was concluded that the use of hot pepper oil in rainbow trout feeds at a concentration of 1‰ positively affects growth performance and feed utilisation rate and increases the welfare level by improving the health parameters in fish.

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

Alesci A, Salvo A, Lauriano ER, Gervasi T, Palombieri D, Bruno M, Pergolizzi S, Cicero N. 2015. Production and extraction of astaxanthin from *Phaffia rhodozyma* and its biological effect on alcohol-induced renal hypoxia in *Carassius auratus*. Nat Prod Res. 29(12):1122–1126.

Alesci A, Cicero N, Salvo A, Palombieri D, Zaccone D, Dugo G, Bruno M, Vadalà R, Lauriano ER, Pergolizzi S. 2014. Extracts deriving from olive mill waste water and their effects on the liver of the goldfish *Carassius auratus* fed with hypercholesterolemic diet. Nat Prod Res. 28(17): 1343–1349.

Aramli MS, Kamangar B, Nazari RM. 2015. Effects of dietary β-glucan on the growth and innate immune response of juvenile Persian sturgeon, *Acipenser persicus*. Fish Shellfish Immunol. 47(1):606–610.

Carthy D, Stevenson J, Roberts M. 1971. Some blood parameters of the rainbow of the trout (Salmo gairdneri, Richardson). J Fish Biol. 5(1):1–8.

FAO. 2016. The State of World Fisheries and Aquaculture 2016: Contributing to food security and nutrition for all food and agriculture Organization of the United Nations, Rome (2016).

Forero MD, Quijano CE, Pino JA. 2009. Volatile compounds of Chile pepper (*Capsicum annuum* L. var. glabriusculum) at two ripening stages. Flavour Fragr J. 24(1):25–30.

Glencross BD. 2009. Exploring the nutritional demand for essential fatty acids by aquaculture species. Rev Aquacult. 1(2):71–124.

Heinemann T, Kullak-Ublick GA, Pietruck B, Von Bergmann K. 1991. Mechanisms of action of plant sterols on inhibition of cholesterol absorption. Eur J Clin Pharmacol. 40(Suppl 1): S59–S63.

Hematzadeh A, Ali Jalali SM. 2017. Effects of dietary sesame oil on growth performance, chemical composition, lipid oxidation, and sensory characteristics of rainbow trout Oncorhynchus mykiss. Nat Prod Res. 28:1–4.

Hornero-Méndez D, Gómez-Ladrón de Guevara R, Minguez-Mosquera MI. 2000. Carotenoid biosynthesis changes in five red pepper (*Capsicum annuum* L.) cultivars during ripening. Cultivar selection for breeding. J Agric Food Chem. 48(9):3857–3864.

Kalogeropoulos N, Alexis MN, Henderson RJ. 1993. Effect of dietary lipids on tissue fatty acid composition of gilthead bream (*Sparus aurata*). In: Kaushik SJ, Luquet P, editors. Fish Nutr Prac. Paris: INRA; p. 257–267.

Lo Cascio P, Calabrò C, Bertuccio C, Paterniti I, Palombieri D, Calò M, Albergamo A, Salvo A, Denaro MG. 2017. Effects of fasting and refeeding on the digestive tract of zebrafish (*Danio rerio*) fed with Spirulina (*Arthrospira platensis*), a high protein feed source. Nat Prod Res. 31(13):1478–1485.

Matsufuji H, Nakamura H, Chino M, Takeda M. 1998. Antioxidant activity of capsanthin and the fatty acid esters in paprika (*Capsicum annuum*). J Agric Food Chem. 46(9):3468–3472.

Oboh G, Rocha JBT. 2007. Polyphenols in red pepper [*Capsicum annuum* var. aviculare (Tepin)] and their protective effect on some pro-oxidants induced lipid peroxidation in brain and liver. Eur Food Res Technol. 225(2):239–247.

Ou B, Huang D, Hampsch-Woodill M, Flanagan JA, Deemer EK. 2002. Analysis of antioxidant activities of common vegetables employing oxygen radical absorbance capacity (ORAC) and ferric reducing antioxidant power (FRAP) assays: a comparative study. J Agric Food Chem. 50(11):3122–3128.

Pérez-Gálvez A, Garrido-Fernández J, Mínguez-Mosquera MI, Lozano-Ruiz M, Montero-de-Espinosa V. 1999. Fatty acid composition of two new pepper varieties (*Capsicum annuum* L. cv. Jaranda and Jariza). Effect of drying process and nutritional aspects. J Am Oil Chem Soc. 76(2):205–208.

Wiegertjes GF, Stet RJ, Parmentier HK, van Muiswinkel WB. 1996. Immunogenetics of disease resistance in Fish: a comparative approach. Dev Comp Immunol. 20(6):365–381.