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The selection of viscerosomatic and hepatosomatic indices for the measurement and analysis of *Oreochromis niloticus* condition fed with varying dietary maltose levels

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ABSTRACT
The present study was carried out to measures and analyses the condition of Nile tilapia, *Oreochromis niloticus* fed with different dietary maltose by using viscerosomatic and hepatosomatic indices. Five isonitrogenous and isocarloric experimental diets were formulated to contain different maltose levels (0.0, 20, 25, 30 and 35%). Triplicate groups of fish (average body weight 2.1±0.2 g) were fed for 90 days. At the end of the feeding trial the viscerosomatic index (VSI) and hepatosomatic index (HSI) were analyzed based on total body weight and organ weights of the fish. The results showed no significant differences ($P<0.05$) in the viscerosomatic (VSI) values among the diets, but the hepatosomatic index (HSI) values, shows significant differences between both diets 30 and 35% maltose (0.55) compared with the control (0.39), while no significant differences between other diets (20 and 25% maltose) and control. The results of this study show that addition of maltose to fish diet can promote improved fish condition.

Keywords: *Oreochromis niloticus.* viscerosomatic index. hepatosomatic index, dietary maltose.

1. Introduction
The study of condition, now usual practice in fisheries biology, is usually based on the analysis of length-weight data and other indices have also been used to evaluate the fitness of fish populations [1]. In addition knowledge of some quantitative aspects in fishes is an important tool for the study of biological fundamentals such as viscerosomatic and hepatosomatic indices, because measurement and analysis these indices are very important in assessing food value. The dietary carbohydrates are generally the major source of energy in most domestic animal diets, and carbohydrate-containing feedstuffs are available in great quantities at low prices [2]. The ability of fish to utilize carbohydrate varies among fish [3]. Moreover, warm water herbivorous or omnivorous fish utilize much higher levels of carbohydrate than carnivorous coldwater fish and marine fish [4]. The excess dietary carbohydrate may lead to fat deposition, which is the potential for increased rate of lipid oxidation in fish, and could affect the health status of the fish and nutritional qualities of fish fillets [5]. The study of viscerosomatic and hepatosomatic indices has an important role in the metabolism of the fishes, related to digestion and absorption, synthesis and secretion of digestive enzymes and carbohydrate metabolism [6]. Although, the viscerosomatic and hepatosomatic indices and feeding habits of tilapia have been studied by (Gümüş and Ikiz, [7], Ahmad *et al*, [8], unfortunately, the information on the relationship between dietary maltose levels and these indices is scant. Thus, the present study aims to provide information regarding the both indices (Viscerosomatic and hepatosomatic) and dietary levels of maltose for Nile tilapia fingerlings (*Oreochromis niloticus*), with a view to determining whether the fishes are in good condition.

2. Materials and Methods
The trial occurred at Fresh Water Hatchery, Faculty of Fisheries and Aqua-Industry (FPAI), Universiti Malaysia Terengganu (UMT), Malaysia. A total 450 Nile tilapia, *Oreochromis niloticus* fingerlings, with a mean initial weight of (2.1±0.2 g), were randomly distributed into 15 tanks with three tanks receiving the same diet. The fish were fed on five diets incorporated with different levels of maltose (0, 20, 25, 30 and 35%) for 90 days. The formulations and proximate analysis of experimental diets are presented in Table 1 and Table 2, and analysed according to Association of Official Analytical Chemists procedures [9], for dry matter, protein, lipid, ash and fiber. At the end of the trial, hepatosomatic index (HSI) and

viscerosomatic index (VSI) were calculated. To determine HSI, liver weights were determined using the formula: HSI (%) = 100 x (liver weight [g] /whole fish weight [g]). Similarly, viscera weights were also recorded to the nearest mg and VSI determined using the formula: VSI (%) = 100 x (viscera weight [g]/whole fish weight [g]). All the results were subjected to analysis of variance (ANOVA). Duncan multiple range test [10] was further used to evaluate the mean differences at 0.05 significant levels.

Table 1: Composition of the experimental diets (% dry wt)

Feed ingredient	Feed A (0.0% Mal)	Feed B (20% Mal)	Feed C (25% Mal)	Feed D (30% Mal)	Feed E (35% Mal)
Fish meal	12	12	12	12	12
Soya bean	38	38	38	38	38
Wheat flour	10	10	10	10	10
Maltose	0	20	25	30	35
Cellulose	35	15	10	5	0
Palm oil	3	3	3	3	3
Mineral premix	0.5	0.5	0.5	0.5	0.5
Vitamin premix	0.5	0.5	0.5	0.5	0.5
Vitamin C	0.4	0.4	0.4	0.4	0.4
Binder (CMC) Chromic oxide	0.5 0.1	0.5 0.1	0.5 0.1	0.5 0.1	0.5 0.1

Table 2: Mean ±S.D. Proximate analysis of experimental diets

Ingredient (%)	Feed A (0.0% Mal)	Feed B (20% Mal)	Feed C (25% Mal)	Feed D (30% Mal)	Feed E (35% Mal)
Moisture	8.86±0.93	8.39±0.82	9.22±0.49	9.82±0.63	9.62±0.03
Protein	33.27±0.87	33.70±0.43	33.85±0.29	33.56±0.73	33.27±0.44
Lipid	4.67±0.04	4.83±0.04	4.68±0.08	4.83±0.17	4.67±0.01
Ash	4.44±0.02	4.77±0.02	4.81±0.02	4.94±0.09	4.88±0.26
Fiber	13.62±0.68	11.23±0.09	8.93±0.20	8.71±0. 20	8.71±0.03
NEF	35.14±0.94	37.08±0.57	37.91±0.50	38.14±0.61	38.85±0.32
Energy(kJ g^{-1})	18.94±0.89	18.66±0.13	19.17±0.19	19.67±0.49	19.26±0.22

3. Result

The viscerosomatic index (VSI) of the fingerlings was recorded as 1.563% After 90 days, there was no significant difference (P<0.05) in the VSI of the fingerlings fed on control feed, feed B, feed C, feed D and feed E. The highest VSI was recorded (1.663) in the fingerlings fed on feed B and the least (1.498) in the fingerlings fed on feed C. The VSI of the fingerlings fed on control feed (A), feed C and feed E were found to be almost the same.

The hepatosomatic index (HSI) of the fingerlings was recorded as 0.49% after 30 days, there was significant difference (P<0.05) in the HSI of the fingerlings fed on control feed (A) and both feed D and feed E. The highest HSI was recorded (0.55%) in the fingerlings fed on both feed D and feed E, and the least (0.39%) in the fingerlings fed on control feed (A). There was no significant difference (P<0.05) in the HSI of the fingerlings fed on both feed C and feed B compared with control feed.

Table 3: Viscerosomatic index (VSI) and Hepatosomatic index (HSI) of Nile tilapia fingerlings fed with diets containing maltose after 90 days.

Parameters (%)	Feed A (0.0% Mal)	Feed B (20% Mal)	Feed C (25% Mal)	Feed D (30% Mal)	Feed E (35%Mal)	LSD
Viscerosomatic index (VSI)	1.50±0.58	1.66±0.31	1.49±0.45	1.61±0.31	1.54±0.43	0.651
Hepatosomatic index (HSI)	0.39±0.068b	0.47±0.077a b	0.49±0.056a b	0.55±0.046a	0.55±0.058 a	0.102

Mean with a common letter shown in rows are not significantly different, (N = 30)

4. Discussion

The mean of viscerosomatic index and hepatic somatic index of Nile tilapia fed the experimental diets were all normal with no observable irregularity. This indicated that the maltose had no overt physiological abnormalities. VSI and HSI were not affected by the different levels of maltose in the diets. Moreover, VSI was

similar or a little higher than those fish fed the control diet (Table 3).While, HSI was slightly higher for fish fed with high maltose level diets. This result are similar to Ahmad *et al*. [8] who reported the viscerosomatic and hepatosomatic indexes (HSI) increased with the increase in dietary carbohydrate level, and also in agreement with the suggestions of Gümüş and Ikiz [7]. While this differs from Amoah *et al.*, [11] who reported that in *Micropterus salmoides*, liver size was increased as carbohydrates were lower than 20% of diet. The excess carbohydrate got deposited in the liver as fat. The results of the present finding are similar to those of Lee *et al*. [12], Nandeesha *et al*. [13] and Kumar et al. [14] who reported the lowest VSI and HSI in *C. carpio* fed on higher crude protein and lower carbohydrate diets. Other authors who described the same trend also include Hamre *et al*. [15], Krogdahl *et al.* [2] and Gumus and Ikiz [7]. Higher condition factors indicated good health with an isometric growth, which is desirable for fish in fish farms [16].

5. Conclusion

Based on organ indices, this work concludes that the hepatosomatic index (HSI) values increased when increased dietary maltose levels, while no effect on viscerosomatic (VSI) index values. Therefore, based on the results of this study, the viscerosomatic index and hepatosomatic index are important indicators of fish condition status.

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