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Evaluation of metabolizable nutrient values of Tomato Pomace (TP) in Nile tilapia (*Oreochromis niloticus*)

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Abstract
This study was conducted to investigate the metabolizable Nutrient values of Tomato Pomace (TP) in Nile tilapia (*Oreochromis niloticus*). Ninety days (three month) old fish were divided into 2 groups, each group consists from 12 aquariums, and each aquarium contains 12 Nile tilapia fingerlings whereas the excreta could be collected. Fish in each group were randomly fed basal diet or basal diet mixed Tomato Pomace (TP) at the ratio of 80:20. Their excreta with collected daily for 30 days. Diets and excreta of fish were analyzed for crude protein and gross energy. The metabolizable protein and metabolizable energy of Tomato Pomace (TP) were estimated by using different methods.
The results showed that metabolizable nutrient values of Tomato Pomace (TP) in fish were 0.81% of protein intake, 0.98 kcal/g of metabolizable energy, 0.27% of crude fiber intake, 0.32% of Ether Extract intake and 0.87% of nitrogen free extract (NFE) of intake, respectively.

Keywords: Tomato Pomace (TP), Nile tilapia, *Oreochromis niloticus*, Metabolizable Nutrient.

1. Introduction
Nile tilapia, *Oreochromis niloticus* (Linnaeus, 1758) has often been regarded as one of the excellent candidates for intensive aquaculture production. This is because of their interesting aquaculture characteristics, such as a high growth rate, an ability to maintain good growth at high stocking densities, a good resistance to disease, good food conversion rates and a ready acceptance of artificial feed [1].
In semi – intensive and intensive fish farming systems, aquafeed is the most expensive part of finfish aquaculture, which accounts between 40 to 70% of the total cost of production depending on the intensity of the culturing system; Because it depend on expensive conventional imported ingredients such as fish meal, soybean meal, yellow corn, and barley. It is therefore necessary to look for a new source of non-conventional feed ingredients to reduce feed cost [2] and [3]. Considerable attention has been paid to use non-conventional feedstuffs either as protein or energy sources usually instead of fish meal and yellow corn respectively which represent the largest part balanced diets [4]. Therefore, it is important to find cheep alternative feed resources for fish that can be effectively used to improve fish productivity at least costs.
Presently, the cost of imported protein sources in animal diets is rapidly rising. Thus, the utilization of locally produced protein sources is desperately required.
Tomato is one of the major vegetables and second only to potatoes in terms of world production [5]. While the majority of tomatoes are sold fresh, a little more than one third of the production is processed to make canned tomatoes, tomato juice, tomato paste or puree, sauces and ketchup. Tomato processing yields the following by-products (skin, seed and hulls), which represent 5-13% of the whole tomato [6] and [7]. Tomato pomace is the mixture of tomato peels, crushed seeds and small amounts of pulp that remains after the processing of tomato for juice, paste and ketchup [7]. Tomato seeds are a by-product of tomato cannery, notably from the production of de-seeded canned tomatoes [8]. Fresh tomato by-products have the same drawbacks as other high-moisture feed ingredients: they are costly to transport, they spoil quickly, their nutritive value per kg fresh matter is low and their bulkiness limits intake [8]. For those reasons, tomato pomace, skins and seeds are usually ensiled or dried before being fed to ruminants, poultry, fish and other livestock. They may be particularly helpful during dry periods where other feeds in shortage [9]. This study, therefore, was conducted to investigate

MP and ME values of Tomato pomace (TP) in Nile tilapia (*Oreochromis niloticus*).

2. Materials and Methods
i. Tomato Pomace (Tp)
Tomato pomace (TP) was purchased from a local producer and dried under sunlight for 2 days. Dried Tomato pomace (TP) was ground through a 2 mm screen prior to diet preparation.

ii. Fish for Experimental Work
Ninety days (three-month) old fish were divided into 2 groups; each group consisted of 24 aquariums (12 fish). Fish were kept in metabolic aquariums where their excreta could be totally collected.

iii. Diets for Experimental Design
The basal diet was formulated to meet all nutritional needs for three month old fish recommended by NRC (1993) [10], containing 32% crude protein and 3.44 kcal/ kg ME (Table 1). The fish in the control group received a basal diet. The fish in the tested group were fed a mixture of basal diet and dried Tomato pomace (TP); consisting of 31.88% crude protein and 3.44 kcal/kg metabolizable energy, in the ratio of 80:20. During 25 days preliminary period, the fish were fed diets once daily. Feed intake was recorded weekly. In a 30 days experimental period, the fish were offered 80% of feed intake in a preliminary period. The excreta of fish were collected at 9.00 a.m. and 5.00 p.m. for seven consecutive days. The daily excreta of each aquarium were weighed, sprayed with 10% sulfuric acid and frozen at -20 C. At the end of the experimental period, the excreta of each aquariums was pooled and dried at 60 C. Diets and excreta of fish were analyzed for total nitrogen by Kjeldahl method [11] and gross energy by adiabatic bomb calorimeter (Gallenkamp Autobomb, CBA-350-K, London, UK) using benzoic acid as a standard according to the method of Amerah *et al.* (2008) [12]. Metabolizable nutrients values of Tomato pomace (TP) was estimated using a different methods [13] as demonstrated in the following Equation:

Nutrient Metabolizable of test feed =

$$\frac{\{A- (B \times \text{Fraction of nutrient in basal +Test feed})\}}{\text{Fraction of nutrient from test feed in basal + test feed}}$$

A = Nutrient metabolizable of basal + test feed
B = Nutrient metabolizable of basal

iv. Statistical Analysis
The experimental data were analyzed using the t-test procedure of SPAS (2009) [14]. Values of $p<0.05$ were taken as significant.

Table 1: Ingredient and chemical composition of basal diets

Ingredients	Proportion (%)
Fish meal (60 % CP)	18.75
Soybean meal (48% CP)	31.75
Yellow corn	20
Wheat bran	10
Barley	18
Corn oil	0
Vitamin & Mineral Mix*	0.5
Sodium Chloride (NaCL)	0.5
Calcium carbonate	0.5
Total	**100**
Additive Agar- agar (Binder)	**0.5**
Calculated feeding value	
Dry matter	88.23
Crude protein (CP) %	31.88
Metabolizable Energy (kcal/kg)**	3.44
Ether extract (EE) %	3.59
Crude fiber %	2.84
Nitrogen free extract (NFE)%	52.7
ASH %	7.28

***Vitamin & Mineral Premix Composition:** Each Kg of premix contain : Vitamin A, 8000 IU, D3, 1400 IU; E, 2 IU; K3, 2mg; B1, 2mg; B2, 4mg, B12, 5 mcg; Ca-d-Pantothenat, 5mg; Nicotinamide, 15mg; Folic acid, 0.5 mg; Choline Chloride 100mg; Mn, 33mg; Zn, 25mg; Fe, 12 g; Cu, 2.2mg; I, 1.1mg, and Co, 0.5 mg. (Ultravit Premix, AVICO, Amman, Jordan).*

***** metabolizable Energy = (Based on 4.5 Kcal/g protein, 8.1 Kcal/g fat and 3.49 carbohydrate (NFE) Kcal/g) respectively, according to Pantha (1982), {cal. = 4.184J}.***

3. Results and Discussion
Tomato Pomace chemical composition and subsequent nutritional value depend on the relative proportions of peels, seeds and other remaining materials left by the various steps of the process, which themselves depend on the target tomato product. For instance, the crude protein and fat content of tomato pomace varies with the amount of seeds, which are richer in protein and fat than the peels [6, 16, 15]. It is an easily available, abundant, and inexpensive by-product that can be successfully incorporated into animal feed [17]. The annual tomato Pomace is about 10,000 tonnes in Jordan [18]. The composition of tomato pomace varies according to agricultural and processing practices, the temperature degree of drying, moisture removal and separation of seeds. Tomato pomace is relatively rich in protein (20-24% DM) and fat (10-15 % DM) [18]. Fibre content is high; crude fibre is 30-35% % DM it is not to be easily digested by monogastric and utilized as fish feed; so, there is a need to formulate optimized rations for uses to

avoid metabolic disorders caused by the unbalanced rations of energy and protein and to reduce the tasty factors which might limit feed intake and then the fish performance that leads to low profitability [19, 20, 21]. NDF (50-72% DM) consists largely of ADF (39-60%) [22]. Lignin content (ADL 20-30% DM) [22]. Is extremely important, though some tomato pomace contain less than 7% DM of ADL have been described. Dried tomato seeds have much higher energy level than dried tomato pomace (> 12.6 MJ/kg DM) due to their high fat content [19]. However, Metabolizable nutrient values of Tomato pomace (TP) have never been directly reported in Nile tilapia fingerlings.

The estimated metabolizable nutrient value of Tomato pomace (TP) in fish was shown in (Table 2). Estimated metabolizable of protein (MP) is 0.81% of the protein intake in the tomato pomace, This MP value was lower than that of soybean meal (85% of protein intake) in chickens [23]. Energy intake was high by energy value of fish fed mixed diet and energy retention decreased without significantly ($p<0.05$) when compared with that of fish fed a basal diet. The estimated ME value of Tomato pomace (TP) was 0.98 kcal/ kg in fish (Table 2). The ME is affected by many factors such as age and species of animal, fiber content in feed and enzyme inhibitor in feedstuff [24]. Decreased nutrient utilization in animals fed high fiber content diet was generally due to increasing the rate of passage of diet in the digestive tract [25]. CF content of the used TP in this study scored 32%, which is not different from that reported by Afshar *et al*., (2011) [26], he showed that TP contained about 32.4% of CF. Additionally, Villamide and San Juan (1998) [27] reported that ME contents of sunflower seed meal decreased when its crude fiber, neutral detergent fiber and acid detergent fiber increased. The lower ME value of Tomato pomace (TP), compared to that of other agriculture by product, was probably due to higher fiber content. The finding demonstrated that ME level should be seriously considered when Tomato pomace (TP) is used as energy source in the diets of fish.

4. Conclusion
Metabolizable Nutrient values of Tomato Pomace (TP) in fish were 0.81% of protein intake, 0.98 kcal/g of metabolizable energy, 0.27% of crude fiber intake, 0.32% of Ether Extract intake and 0.87% of Nitrogen Free Extract (NFE) of intake, respectively.

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Table 2: Nutrient Balance of Nile tilapia (***Oreochromis niloticus***) fed basal and mixed diets and Estimated Metabolizable Nutrient (EMN) of tomato pomace (TP)

Parameters	Basal diet	Mixed diet
Feed intake (g/fish)	11.84±0.11	12.01±0.14
Nutrient Composition Of Feed Intake		
Protein intake (g/fish)	3.77±0.03	3.79±0.04
Energy intake (kcal/g)	42.27±0.38 ^{a}	40.06±0.45 ^{b}
CF intake (g/fish)	0.34±0.00^{b}	1.04±-0.01^{a}
EE intake (g/fish)	0.43±0.00^{b}	0.66±0.01^{a}
NFE intake (g/fish)*	6.26±0.06 ^{a}	5.06±0.06 ^{b}
Nutrient Composition Of Excretion		
Protein excretion (g/fish)	1.19±0.40	1.89±0.27
Energy excretion (kcal/g)	7.76± 2.94 ^{a}	0.58±1.16 ^{b}
CF excretion (g/fish)	-0.84±0.23	-0.55±0.20
EE excretion (g/fish)	-1.64 ±0.46 ^{a}	-3.01±0.13 ^{b}
NFE excretion (g/fish)*	4.49±0.20	4.71±0.09
Nutrient Composition Of Retention		
Protein retention (g/fish)	2.59±0.40	1.90±0.26
Energy retention (kcal/g)	34.51± 3.02	39.50±0.99
CF retention (g/fish)	1.18±0.23	1.59±0.21
EE retention (g/fish)	2.06±0.46 ^{b}	3.67±0.12 ^{a}
NFE retention (g/fish)*	1.77±0.19 ^{a}	0.35±0.07 ^{b}
Estimated Metabolizable Nutrient Of Tomato Pomace (TP)		
Metabolizable Protein (MP)	0.81% of protein intake	
Metabolizable Energy (ME)	0.98 kcal/g	
Metabolizable Crude Fiber (MCF)	0.27 % of CF intake	
Metabolizable Ether Extract (EE) (MEE	0.32 % of EE intake	
Metabolizable NFE (MNFE)	0.87 % of NFE intake	

^{Ab} Means in the same row with different superscripts are significantly different ($p<0.05$)

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