Plant Archives Vol. 21, Supplement 1, 2021 pp. 46-54 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
doi link : https://doi.org/10.51470/PLANTARCHIVES.2021.v21.S1.010

EFFECTS OF DIFFERENT LEVELS OF CINNAMON AND CORIANDER POWDERS ON GROWTH PERFORMANCE, FEED UTILIZATION, SURVIVAL RATE AND BODY CHEMICAL COMPOSITION OF COMMON CARP *CYPRINUS CARPIO* L.

Hani Hashim Al-Shakarchi* and Mahmoud A. Mohammad
Department. of Animal Production, College of Agriculture, University of Mosul, Iraq
*Email: dr.mahmoud@uomosul.edu.iq

ABSTRACT

This study was conducted to investigate the effects additive cinnamon and coriander powders on growth, feed utilization, survival rate and body chemical composition, of common carp *Cyprinus carpio* L. for 56 days in class aquaria. 210 fish with initial weight 8±0.5gm\fish .Fish were acclimatized for 21 days before starting the feeding experiment to acclimatize the fish to the aquaria environment. Fish fed dietary cinnamon and coriander powders at levels of 1.25, 1.5, 1.75% against those fed diet without medical plant as control. Analysis of data showed there were significant differences ($P \leq 0.05$) for live body weight, weight gain, feed conversion ratio and protein retention. There were no significant differences among experimental diets with control for specific growth rate, survival rate, food consumption and protein consumption criteria. The addition of cinnamon and coriander powder resulted in a significant superiority ($P \leq 0.05$) in protein efficiency ratio and protein productive value, which depended on the added percentage of these two types of medicinal herbs. The percentage of dry matter and raw protein increased, while the percentage of fat decreased, and the ash content did not affect with the use of adding cinnamon and coriander powder in edible portion of experimental fishes.

Keywords: Cinnamon, coriander, PER, PPV, common carp, chemical body composition.

Introduction

The use of antibiotics led to development of drug-resistant strains and accumulation of many drug residues within fish products and consequently concerns about safety of these foods (Hoseini *et al.,* 2019, Awad and Awaad, 2017 and Citarasu, 2010). These risks necessitate limiting the use of antibiotics in aquaculture operations by replacing them with products that are safer for the animals and environments in which they live (Dawood and Koshio 2016, Song *et al.,* 2014, Hoseini *et al.,* 2019, Awad and Awaad, 2017, and Citarasu, 2010 and Vallejos-Vidal *et al.,* 2016). For these reasons, it has been directed to use of herbs and medicinal plants by researchers as an alternative to antibiotics as medicinal plants have become of great importance as feed additives as an alternative to antibiotics in controlling diseases and reducing side effects from the use of antibiotics and chemotherapy (Hoseini *et al.* 2019 and Awad Awaad, 2017, Citarasu, 2010, Vallejos-Vidal et al., 2016, Volpe *et al.,* 2008). *Cinnamomum* sp. is an important medicinal plant that contains an oily compound called Cinnamaldehyde with vital and pharmacokinetic activities. It is considered analgesic, fever-reducing and antihypertensive (Nagababu and Lakshmaiah, 1992). Research published on the effect of this medicinal plant on aquaculture has examined the effect of cinnamon as an antioxidant (Lin *et al.,* 2003 and Blomhoff, 2004) and the effect of its use on blood sugar (Khan *et al.,* 2003 and Kim *et al.,* 2006 and Verspohl, 2005) and its antagonistic effect the action of fungi (Singh *et al.,* 2007 and Mishra *et al.,* 2009) and bacteria (Chang *et al.,* 2001, Sadıç and Özcan, 2003 and Singh *et al.,* 2007, Abasali and Mohammad, 2010, Al-Abdullah and al-Jazaa, 2015 and Ali *et al.,* 2007) and its effect on cytotoxicity (Sharififar *et al.,* 2009), promoting growth and feed utilization, physiological and blood parameters, in Nile tilapia *Oreochromus niloticus* (Ahmad *et al.,* 2011, Sivagurunathan and Innocent, 2014) and common carp *Cyprinus carpio* L.(Mohammad, 2020, Al-Ashaab *et al*., 2017), and Asian cat fish *hypophthalmus Pangasianodon* (Setiawati *et al*., 2016 and Rolin *et al*. 2015). Coriander seeds contain 40-50% linalool, a powerful antioxidant, microbial and inflammatory compound. Studies have indicated its beneficial effects in fish farming as an anti-fungal poisoning in the Nile tilapia *Oreochromis niloticus* (Salem *et al*., 2010), and cadmium in trout fish *oncorhynchus mykiss* (Ren *et al*., 2006) to enhance growth and immunity and increase survival rate of the rainbow trout (Farsani *et al*, 2019). The aim of the present research is to study the effect of adding two types of medicinal herbs, cinnamon and coriander to the diets of common carp *Cyprinus carpio* L. on growth performance, food efficiency and the chemical composition of the fish body.

Materials and Methods

Study site

The research was conducted in the fish laboratory of the Department of Animal Production in the College of Agriculture and Forestry / University of Mosul for a period of eight weeks from 11/21/2019 until 16/1/2020.

Fish

Common carp *Cyprinus carpio* L., have been used as the main breeding fish in Iraq. 210 carp fish with an average weight of 8 g / fish were distributed to 21 glass ponds with dimensions of 40 x 60 x 40 cm, with ten fishes / pond and three replications / treatment. Fish were acclimated for three weeks before the feeding experiment was carried out on the pond environment and eating food.

Qualitative characteristics of breeding water:

The class aquarium used in the experiment, measuring 60×40×40 cm., using de-chlorinated tap water filled the aquarium to reach 70L., water was replaced 20-30% every 24 hr. after feeding in order to maintain a healthy environment with enough oxygen. The following physical and chemical characteristic such as temperature (24- 26°C); pH (7.7-7.8); Oxygen (5.5-6.0 mg/l).This parameters within the appropriate and recommended limits (FAO, 1981).

Experimental diets

Seven experimental diets were fed to fish, three of which were added *Cinnamomum zeylanicum* powder in three different proportions: 1.25, 1.5, and 1.75% (second, third, and fourth diets), while the fifth, sixth, and seventh diets contained *coriandum sativum* linn and control diet (1) free of cinnamon and coriander. Table (1) shows the components and chemical composition of the experimental diets depending on dry weight. Diets were manufactured as pellets with 3 mm diameter after milling and mixing their ingredients. After being dried, pellets transferred to plastic bags and stored in a freezer at -20°C until immediately prior to feeding. Diets was provided at 5-3% of its live weight, at two meals daily. The amount of feed provided to the fish during the feeding experiment was increased based on the weight of the weight increases that accompany the fish growth every two weeks. All diets were isonitrogenous and isocaloric.

Table 1: Dietary ingredient and proximate (% DM) of the experimental diets contains different levels of cinnamon and coriander.

experimental diets / Ingredients	Control	Cinnamon			Coriander		
		1.25%	1.5%	1.75%	1.25%	1.5%	1.75%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Fish meal	10	10	10	10	10	10	10
Soybean meal	30	30	30	30	30	30	30
Cinnamon powder	—	**1.25**	1.5	1.75	—	—	—
Coriander powder	—	—	—	—	1.25	1.5	1.75
Wheat bran	19	19	19	19	19	19	19
Yellow corn	18.5	18.5	18.5	18.5	18.5	18.5	18.5
Local barley	20	20	**20**	20	20	20	20
Binder (lingotech*)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vita. & Miner. Mix.	1	1	1	1	1	1	1
Food salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lime stone	0.5	0.5	0.5	0.5	0.5	0.5	0.5
chemical analysis							
Dry matter	92.81	93.91	94.13	94.70	94.32	93.65	93.76
Crude protein	25.33	25.48	25.51	25.54	25.50	25.54	25.57
Ether extract	4.75	5.13	6.11	5.49	5.52	7.76	6.84
Crude fiber	6.38	6.63	6.68	6.73	6.73	6.80	6.87
Ash	5.99	5.71	5.78	5.47	5.57	5.77	5.89
NFE	57.55	50.96	50.05	51.47	51.00	47.78	48.59
ME(MG/KG)**	14.1	13.93	13.46	13.7	13.5	13.8	13.7

* lingosulphate feed binder EEC No . E565 (0.5g/kg).
** According to Smith's equation (1979): Protein x 18.5 + Fat x 33.5 + NFE x 13.8.

Growth parameters

Growth parameters calculated to determine the effect of the supplemented of cinnamon and coriander powder on fish growth was calculated according to Recker, (1975) and Castell and Tiews(1980). Feed utilization and protein retention parameters was calculated according to Stuart and Hung (1989) and Zehra and Khan (2012) respectively.

Analytical methods

Seven fish from each treatment were randomly sampled and stored at -20°C in freezer for proximate composition at the end of experiment. Proximate analysis of diets and fish were determined according to the method of AOAC (2000). Crude protein content was determined using the Kjeldahl method and crude lipid was analyzed by ether extraction, moisture content by a dry oven drying at 50°C for 24 h and ash by a furnace muffler.

Statistical analysis

Data were analyzed using SPSS version 25 windows (SPSS, USA, 2017) software, using complete randomized design (CRD) to determine the effects of additive of cinnamon and coriander on fish growth and feed utilization. Duncan's multiple range test (Duncan, 1955) were used to determine the significant of differences between groups. All results were expressed as mean ± se, significant difference were expressed a significant level of ($p \leq 0.05$).

Results and Discussion

In this research, several growth criteria were used to evaluate growth performance of fish, as fish were fed on diets containing cinnamon and coriander powder in different

proportions. As the addition of medicinal herbs in general enhances growth by supporting the content of these herbs of antioxidants and other growth-promoting compounds that enable the organism to be the main nutrients in the diet that enhances the content of the body of fish, represented by protein, fats and mineral elements (ash) Which is reflected in the increase in the body's content of fish that are fed these two types of spices.

Effect of treatments on growth criteria

Final weight and total daily weight gain:

The results of the statistical analysis of the standard total live weight, the total daily increase and the daily growth rate showed that the addition of cinnamon and coriander powder had a positive and significant effect (P≤ 0.05) in increasing the values of these standards compared with the control diet. The results recorded in Table 2 for the final weight standard indicate that common carp were fed diets containing cinnamon powder, namely the second, third and fourth diets (17.06, 17.86 and 17.30 g/fish) and coriander powder, which were the fifth, sixth and seventh feed (17.16, 17.52 and 17.40 g/fish) was significantly higher (P≤ 0.05) than fish fed on control diet (15.43 g/fish. Results of the statistical analysis of the total weight gain and daily growth rate showed that the addition of cinnamon and coriander powder had a positive and significant effect (P≤ 0.05) in these two criteria compared to the control diet. The best of these values obtained when feeding fish on diets containing coriander by 1.5% and 1.75% (diet 6 and 7) which amounted to 9.55 and 9.50 g / fish, while daily growth rate was 0.170 and 0.169 g / fish \ day respectively. These values mentioned above for these two criteria differed significantly (P≤ 0.05) compared with the control diet which reached 6.92 g / fish and 0.123 g / fish / day, respectively, as well as with fish fed on fourth and fifth diets.

Table 2: Effect of cinnamon and coriander on final weight, weight gain, and daily growth rate criteria of common carp (Mean ± SE).

Criteria / Diets	Initial body weight (gm\fish)	Final body weight (gm\fish)	Total weight Gain (gm\fish)	Daily weight gain (gm/fish/day)
(1) Control	8.51 ± 0.41 a	15.43 ± 0.66 b	6.92 ± 0.58 d	0.123 ± 0.01 d
(2) Cinnamon 1.25%	8.09 ± 0.39 a	17.06 ± 0.27 a	8.97 ± 0.26 ab	0.160 ± 0.00 ab
(3) Cinnamon 1.5%	8.81 ± 0.11 a	17.86 ± 0.17 a	9.04 ± 0.27 ab	0.161 ± 0.00 ab
(4) Cinnamon 1.75%	9.32 ± 0.08 a	17.30 ± 0.07 a	7.97 ± 0.13 c	0.142 ± 0.00 c
(5) Coriander 1.25%	8.56 ± 0.25 a	17.16 ± 0.18 a	8.60 ± 0.12 bc	0.153 ± 0.00 bc
(6) Coriander 1.5%	7.96 ± 0.49 a	17.52 ± 0.57 a	9.55 ± 0.09 a	0.170 ± 0.00 a
(7) Coriander 1.75%	7.89 ± 0.09 a	17.40 ± 0.05 a	9.50 ± 0.06 a	0.169 ± 0.00 a

*Means not sharing a common superscript letter are significantly differences(P>0.05).

This significant superiority of the growth parameters is due to the cinnamon powder's content cinnamaldehyde, polyphenol, and flavonoids that exhibit antioxidant activity and positive effects in improving metabolism (Setiawati *et al.,* 2016a).

Such positive results obtained in the final weight criterion when cinnamon leaf powder and extract were added to the Nile tilapia feed (Abdel-Tawwab *et al.* (2018) Sivagurunathan and Innocent, 2014) and Setiawati et al (2016a) for Asian catfish *Pangasianodon hypophthalmus* and Setiawati *et al.* (2016a) for Asian catfish *Pangasianodon hypophthalmus* Add coriander seed extract to the feed of a trout (Farasani *et al,* 2019). These results were inconsistent with Dedi *et al*. (2016) who did not obtain significant differences for final weight of common carp. Whereas, weight gain of common carp increased compared to the control diet when adding cinnamon extract (Stoyanova *et al.* 2018), cinnamon powder (Mohammad, 2020) and catfish (Begum *et al.* 2018) and Nile tilapia (Ahmad *et al.,* 2011).

Relative growth rate, specific growth rate and survival rate:

Results of statistical analysis showed that fish fed on the sixth and seventh diets significantly (P≤ 0.05) contained coriander powder by 1.5% and 1.75%, respectively, (Table 3) in the criterion of the relative growth rate which reached to 120.71% and 120.49%, respectively, which Significant superiority (P≤ 0.05) over fish fed by control diet (81.79%).

Addition of cinnamon (1.25%, diet 2 and 1.5% cinnamon, diet 3) had a positive effect in increasing relative growth rate, but not significant differences reported between fish fed on 2nd (111.77%) and 3rd (102.71 %) diets. Depending up on above results of the relative growth rate, medicinal herbs have a positive effect in improving growth rates, and relative growth rate.

Results of the statistical analysis of the specific growth rate (SGR) of fish fed on different experimental diets indicated that there were no significant differences with control diet (except for the second diet), which decreased significantly (P≤ 0.05) with fish fed on seventh and second diet, which reached 1.21 and 1.06 respectively. However, Muhammad (2020) found no significant differences in SGR criterion when cinnamon powder was added to common carp feed. It is clear from what has been mentioned above regarding the positive effects of adding cinnamon and coriander powder in comparison to the control diet in most of the growth parameters including total weight gain, daily

weight gain and relative growth rate. Due to the fact that these two types of medicinal herbs contain anti-oxidants, they are represented by the presence of cinnamon of Polyphenols, flavonoids and tannins (Kwon *et al.,* 2009; Gruenwald *et al.,* 2010), Linalool compounds, limonene, α pinene, and camphene in coriander essential oils (Wei and Shibamoto, 2007). In the Because these two types of medicinal herbs, cinnamon and coriander, contain antioxidants, represented by polyphenols, flavonoids and tannins for fish fed diet contained cinnamon. Other studies have found that there was a significant difference in SGR by Begum *et al*. (2018), Setiawati *et al*. (2016a), Rahmawati, Ubaidillah (2017), Al Hadidi (2016), Ahmad et al (2011) and Coriander Farsani *et al.,* 2019).

The positive growth results obtained in this research may be related to nutrient protection in intestine due to effectiveness of the coriander seed extract in the eradication of germs and bacterial pathogens in the intestine as well as to increase levels of digestive enzymes, improve cellular respiration and absorbed nutrients (Awad, Awaad, 2017; Citarasu, 2010; Begnami *et al.* 2018 and Talapatra *et al.* 2010).

The environmental conditions in which this experiment was conducted was within recommended ranges were positively reflected in the increase survival rate of fish, which reached to 100% for all treatments (Table 4). These results consistent with Setiawati *et al.* (2016a), Rahmawati and Ubaidillah (2017), Stoyanova *et al.* (2018) Begum *et al.* (2018), Ahmad *et al.* (2011), Dedi *et al.* (2016) Setiawati *et al.* (2016a), Ahmad *et al.* (2011) with adding cinnamon and Farsani *et al*. (2019) for coriander.

Table 3: Effect of cinnamon and coriander on relative growth rate, specific growth rate and survival rate criteria of common carp (Mean ± SE)**.**

Criteria / Diets	Relative Growth Rate (RGR)	Specific Growth Rate (SGR)	Survival Rate (%)
(1) Control	81.79 ± 8.85 d	1.19 ± 0.05 ab	100 %
(2) Cinnamon 1.25%	111.77 ± 8.58 ab	1.06 ± 0.01 b	100 %
(3) Cinnamon 1.5%	102.71 ± 4.45 abc	1.15 ± 0.07 ab	100 %
(4) Cinnamon 1.75%	85.59 ± 2.12 cd	1.10 ± 0.02 ab	100 %
(5) Coriander 1.25%	100.66 ± 4.12 bc	1.18 ± 0.06 ab	100 %
(6) Coriander 1.5%	120.71 ± 6.41 a	1.09 ± 0.02 ab	100 %
(7) Coriander 1.75%	120.49 ± 2.19 a	1.21 ± 0.05 a	100 %

*Means not sharing a common superscript letter are significantly differences (P> 0.05).

Food consumption and feed conversion ratio:

The results of the statistical analysis included in Table (4) showed there were no significant differences (P≤ 0.05) in total food intake (g/fish), which ranged between 19.70 to 22.28. It is noted from the data recorded in Table (4) the value of the feed conversion ratio decreased significantly (P≤ 0.05) for fish fed on diets contained cinnamon and coriander powder by 1.25, 1.50 and 1.75% compared to control diet (except for the fourth diet). Feed conversion rate for fish fed on diets containing coriander powder, which are the fifth, sixth and seventh, were 2.42, 2.11 and 2.23, respectively, and 2.20, 2.38 and 2.79 for fish fed on diets containing cinnamon powder, which are the second and third feeds, respectively, while it was 2.86 for control diet.

It is noted from the above mentioned results that addition of cinnamon powder has enhanced utilization of fish from nutrients, as Abdel-Tawwab *et al*. (2018) mentioned that adding cinnamon to diets of Nile tilapia fish has enhanced utilization of nutrients due to the high activity of digestive enzymes that contribute to metabolism food and inhibit the possible pathogens in digestive system and thus increase the numbers of beneficial microorganisms, enhancing activity of microbial enzymes that improve feed digestion and nutrient absorption. These researchers also mentioned that adding cinnamon powder promotes the secretion of digestive enzymes, namely, lipase, protease, innate immunity, and amylase (NO, NBT, and lysozyme activity). Our current results for total food intake agreed with Setiawati *et al*. (2016a), for Asian catfish, while this results did not agree with Abdel-Tawwab *et al*. (2018), Ahmad *et al.* (2011) and Dedi *et al.* (2016).

Feed conversion ratio criterion for our current study consistent with Ahmad *et al*. (2011) for Nile tilapia, Rahmawati and Ubaidillah (2017). Stoyanova *et al.* (2018) for catfish (Setiawati et al. 2016a) and Dedi *et al.* (2016) for tilapia, on the other hand Abdel-Tawwab *et al.* (2018) did not notice significant differences when feeding tilapia. Farsani *et al.* (2019) in rainbow trout feeding on diets containing different levels of coriander seed extract.

Table 4: Effect of cinnamon and coriander on food intake, feed conversion ratio and feed efficiency ratio of common carp (Mean± SE)**.**

Criteria / Diets	Food intake (g/f)	Food intake (g/f/d)	Feed conversion ratio	Feed efficiency Ratio (%)
(1) Control	19.75 ± 1.75 a	0.35 ± 0.03 a	2.86 ± 0.19 a	35.21 ± 2.45 b
(2) Cinnamon 1.25%	19.70 ± 1.12 a	0.35 ± 0.02 a	2.20 ± 0.16 c	45.95 ± 3.74 a
(3) Cinnamon 1.5%	21.47 ± 0.66 a	0.38 ± 0.01 a	2.38 ± 0.14 bc	42.30 ± 2.68 ab
(4) Cinnamon 1.75%	22.28 ± 0.33 a	0.39 ± 0.00 a	2.79 ± 0.06 ab	35.81 ± 0.86 b
(5) Coriander 1.25%	20.84 ± 0.46 a	0.37 ± 0.00 a	2.42 ± 0.08 bc	41.32 ± 1.46 ab
(6) Coriander 1.5%	20.18 ± 1.07 a	0.36 ± 0.01 a	2.11 ± 0.11 c	47.60 ± 2.57 a
(7) Coriander 1.75%	21.23 ± 1.10 a	0.37 ± 0.01 a	2.23 ± 0.10 c	44.98 ± 2.07 a

*Means not sharing a common superscript letter are significantly differences (P> 0.05).

Retention protein, protein efficiency ratio and protein productive value:

Results of statistical analysis showed the presence of significant differences (P≤ 0.05) in the criterion of protein retention between fish fed at cinnamon and coriander powder compared with control diet (Table 5). The effect of adding two types of medicinal herbs had a significant effect on the protein efficiency ratio where the PER values for fish fed on second treatment (cinnamon 1.25%), which reached 1.80, differed significantly (P≤ 0.05) with fish fed at control treatment (1.38). PER values increased significantly when fish fed on sixth and seventh diets (1.87 and 1.76) compared with control diet.

Table 5: Effect of cinnamon and coriander on protein intake, protein retention, protein efficiency ratio, and protein productive value criteria of common carp (mean± SE)**.**

Criteria / Diets	Protein Consumption (gm/fish)	Protein Retention (gm / fish)	Protein Efficiency Ratio (PER)	Protein Productive Value % (PPV)
(1) Control	5.02 ± 0.44 a	1.19 ± 0.07 b	1.38 ± 0.09 b	24.03 ± 1.70 b
(2) Cinnamon 1.25%	5.01 ± 0.28 a	1.76 ± 0.05 a	1.80 ± 0.14 a	35.51 ± 3.20 a
(3) Cinnamon 1.5%	5.46 ± 0.17 a	1.68 ± 0.04 a	1.66 ± 0.10 ab	30.91 ± 1.01 a
(4) Cinnamon 1.75%	5.67 ± 0.08 a	1.66 ± 0.06 a	1.40 ± 0.03 b	29.46 ± 1.60 ab
(5) Coriander 1.25%	5.30 ± 0.11 a	1.67 ± 0.10 a	1.62 ± 0.05 ab	31.69 ± 2.41 a
(6) Coriander 1.5%	5.13 ± 0.27 a	1.59 ± 0.13 a	1.87 ± 0.10 a	33.18 ± 1.93 a
(7) Coriander 1.75%	5.40 ± 0.28 a	1.77 ± 0.08 a	1.76 ± 0.08 a	32.79 ± 0.32 a

*Means not sharing a common superscript letter are significantly differences (P> 0.05).

The results we obtained for this criterion may be due to the effective compounds present in medicinal herbs that act as antibiotics in reducing the effect of pathogenic microorganisms in a manner that ensures the increase and stability of beneficial microorganisms in the gut that have a positive effect that is reflected in the health of fish and their nutrient uses that reflected positively in increasing growth and improving the efficiency of feed. Al-Hadidi (2016) indicated that protein digestibility coefficient increased when adding cinnamon at a level of 1% and 2.5% in diet of common carp. Cinnamon has antimicrobial activity (Singh *et al*., 2007; Starliper *et al*., 2015; Shan *et al*., 2009; Matan *et al*., 2006). Antimicrobial activity of cinnamon is mainly due to the cinnamaldehyde compound found in the cinnamon bark (Wong *et al*., 2014). Cinnaldehyde also has a strong antibacterial activity against several strains of bacteria, including *Escherichia coli* and *Pseudomonas aeruginosa* (Chang *et al*., 2001). Farsani *et al.* (2019) noted that coriander seeds contain 40-50% linenol is a powerful antioxidant, microbial and inflammatory compound. These results consistent with other researchers obtain significant differences in the PER criterion by adding gonorrhea cinnamon in diet of Nile tilapia (Ahmad *et al*., 2011) and common carp (Al-Hadidi, 2016). While Mohammad (2020) did not get significant differences when adding cinnamon powder in common carp diet.

Results recorded in Table (5) showed a significant($P \leq 0.05$) increase value of protein productive value (PPV) for all cinnamon and coriander treatments(except for the fourth diet), which reached to 35.51% and 30.91% for diet 2 and 3 respectively, and 31.69%, 33.18% and 32.79% for diet 5, 6 and 7, respectively, compared with control diet (24.03%). The increase in protein retention as a result of adding cinnamon may be due to contribution of effective polyphenol compounds in improving metabolism of sugar and fatty acids in the blood, as well as improving health of fish, enhanced protein availability, which reflected in protein retention, which contributed on live biomass of fish (Setiawati *et al.*, 2016a). Cinnamon containing cinnamaldehyde compounds helped stimulate insulin-like growth factor (IGF-1) (Takasao *et al*., 2012). Which has a positive role in promoting production of protein and colagen deposition, which plays a major role in increasing biomass of fish (Vinasyiam *et al.,* 2016 , NRC, 2011). Mohammad (2020) and Rolin *et al*. (2015) found that adding cinnamon increased levels of protein deposited in body compared to control. while Setiawati *et al.* (2016a) not found significant differences when added cinnamon leaf extract and powder in Asian catfish diet.

Chemical composition of body fish

Results of statistical analysis (Table 6) indicated that the percentage of moisture decreased, while dry matter percentage increased significantly ($P \leq 0.05$) in edible portion for fish fed on experimental diets contained cinnamon powder (third, fourth and seventh diet) and coriander powder compared to control diet. Dedi *et al*. (2016) reported high moisture with e addition of cinnamon leaves in body of common carp. While results obtained by Mohammad (2020) and Al-Hadidi (2016) indicated there were no significant differences in percentage of dry matter when fed common carp on different levels of cinnamon powder.

Results of statistical analysis indicated a significant decrease ($P \leq 0.05$) in percentage of fats (Table 6), where level of body fat for fish fed at cinnamon powder decreased compared to control diet. Cinnamon contains polyphenol and cinnamaldehyde, which improve glucose and fatty acid metabolism as well as their antioxidant activity (Gruenwald *et al.,* 2010). Lopes *et al.* (2015) emphasized that cinnamon can improve metabolism of fatty acids in adipose tissue and improves lipid metabolism (Jayaprakasha and Rao, 2011). low level of body fat in our current study agrees with Mohammad (2020) and Dedi *et al*. (2016), who found a significant decrease in percentage of body fat for common carp. Setiawati *et al.* (2016b) reported adding cinnamon can reduce fat, cholesterol and triglyceride content in catfish meat, while Al-Hadidi (2016) and Sitiawati (2016a) did not obtained significant differences in common carp and Asian catfish, respectively. Likewise no significant differences were recorded between all treatments for moisture and ether extract criteria when Abdel- Tawwab *et al.* (2018) fed Nile tilapia at diet contained cinnamon.

The use of cinnamon and coriander powder resulted in a significant increase ($P \leq 0.05$) in protein levels in edible portion compared to control diet (Table 6). The results included an increase in content of raw protein consumed portion of fish fed on diets containing cinnamon powder, which may be due to cinnamon content of cinnamaldehyde compound, which has ability to activate insulin-like growth factor (IGF-1), which dynamically enhances protein and collagen production in body tissues caused increases deposition of proteins to build muscle in body (Abdel-Tawwab *et al.,* 2018 and Takasao *et al*., 2012). As well as contribution of polyphenol compounds that have efficacy in improving blood sugar metabolism, fatty acids as well as their role in improving fish health, thus making the protein prepared to supporting fish growth (Setiawati *et al*., 2016a).

Table 6: Effect of cinnamon and coriander on chemical composition (%) of the edible common carp (mean ± SE).

Criteria / Diets	Moisture	Dry weight	Ether extract	Total protein	Ash%
(1) Control	77.49 ± 0.33 ab	22.50 ± 0.33 bc	8.72 ± 0.09 a	16.22 ± 0.01 b	3.73 ± 0.01 a
(2) Cinnamon 1.25%	77.62 ± 0.14 a	22.37 ± 0.14 c	6.32 ± 0.10 bc	17.60 ± 0.03 a	3.75 ± 0.07 a
(3) Cinnamon 1.5%	75.81 ± 0.17 c	24.18 ± 0.01 a	6.35 ± 0.09 b	17.01 ± 0.03 ab	3.55 ± 0.13 a
(4) Cinnamon 1.75%	76.08 ± 0.24 c	23.91 ± 0.24 a	5.99 ± 0.03 cd	17.90 ± 0.03 a	4.00 ± 0.05 a
(5) Coriander 1.25%	76.29 ± 0.35 bc	23.70 ± 0.35 ab	6.38 ± 0.05 b	17.41 ± 0.05 ab	4.10 ± 0.04 a
(6) Coriander 1.5%	76.32 ± 0.67 bc	23.67 ± 0.67 ab	5.67 ± 0.43 cd	16.68 ± 0.05 ab	3.67 ± 0.07 a
(7) Coriander 1.75%	75.94 ± 0.38 c	24.05 ± 0.38 a	5.58 ± 0.19 d	17.14 ± 0.04 ab	3.68 ± 0.08 a

*Means not sharing a common superscript letter are significantly differences ($P > 0.05$).

Jayaprakasha and Rao (2011) also mentioned that cinnamaldehyde, flavonoids and polyphenol compounds present in cinnamon have effects in improving metabolism as well as their antioxidant activities that increase effectiveness of immune system, maintain cell physiology, reduce cell damage caused by free radicals and oxidative stress (Sabitha *et al*., 2014). Results of the current study of crude protein criteria are in agreement with the results obtained by Abdel Tawab *et al*. (2018) for Nile tilapia and Setiawati *et al.* (2016a) for common carp, but not consistent with Mohammad (2020) and Al-Hadidi (2016) Who did not obtain significant differences in common carp.

Results recorded in Table (6) showed there were no significant differences ($P \leq 0.05$) in ash content between all

experimental diets. These results are consistent with Mohammad (2020) and Al-Hadidi (2016) in common carp, while Abdel- Tawwab *et al*. (2018) reported a significant decrease in ash content of Nile tilapia. Ahmad *et al.* (2011) and Abdel Wahab *et al*. (2007) did not obtain significant differences in chemical composition of body content of dry matter, protein, fats and ash for tilapia due to addition of cinnamon.

Conclusion

Results of present research showed that the diet supplemented with cinnamon and coriander powder improves the growth performance, feed conversion ratio, protein retention, and protein productive value. While the percentage of fat was significantly decreased ($P \leq 0.05$) in the edible portion of fish fed at these two types of medicinal herbs compared with the control diet.

Acknowledgment

The author are very grateful to university of Mosul, College of Agriculture and Forestry / for their provided facilities, which helped to improve quality for this work.

References

Abasali, H. and Mohamad, S. (2010). Immune response of common carp (*Cyprinus* carpio) fed with herbal immunostimulants diets. Journal of Animal and Veterinary Advances, 9(13): 1839-1847.

Abdel-Tawwab, M.; Samir, F.; Abd El-Naby, A.S. and Monier, M.N. (2018). Antioxidative and immunostimulatory effect of dietary cinnamon nanoparticles on the performance of Nile tilapia, *Oreochromis niloticus* (L.) and its susceptibility to hypoxia stress and *Aeromonas hydrophila* infection. Fish & shellfish immunology, 74: 19-25.

Ahmad, M.H.; El-Mesallamy, A.M.; Samir, F. and Zahran, F. (2011). Effect of cinnamon (*Cinnamomum zeylanicum*) on growth performance, feed utilization, whole-body composition, and resistance to *Aeromonas hydrophila* in nile tilapia. Journal of Applied Aquaculture, 23(4): 289-298.

Al-Abdullah, B.Y. and Al-Jazaa W.F.; (2015). Production of Functional Drinks From Some Medicinal Herbs and Studying their Microbial Tests and Diagnosis The Chemical Components in them by GC-MS Technique. Tikrit Journal for Agricultural Sciences 15(3):171-183. [in Arabic].

Al-Ashaab, M.H. and Ahmed, M.A. and Atee, R.S. (2017). The Aditional Effect of Anise and Cinnamon in Indicia Growth and Some Physiological Characteristics of Common Carp (*Cyprinus carpio* L.) Diets. Diyala Journal for Agricultural Sciences 9(2):16-28. [in Arabic].

Al-Hadidi, M.A.A. (2016). Effect of using anise and cinnamon In diets of common carp *cyprinus carpio* L. On growth and physiological characteristics. Master Thesis.; college of Agriculture, Diyala university.

Ali, N.A. and Al-Kaisey M.T. and Al-Zubaidi L.A. (2017). Inhibition activity of bark cassia cinnamon exctract against some microorganisms. Iraqi Journal. Biotech.; 6 (1):71-78. (in Arabic).

Association of official analytical chemists (A .O .A.C): (2000). 17 th ed V11 USA.

Awad, E. and Awaad, A. (2017). Role of medicinal plants on growth performance and immune status in fish. Fish & shellfish immunology, 67: 40-54.

Begnami, A.F.; Spindola, H.M.; Ruiz, A.L.T.G.; de Carvalho, J.E.; Groppo, F.C. and Rehder, V.L.G. (2018). Antinociceptive and anti-edema properties of the ethyl acetate fraction obtained from extracts of *Coriandrum sativum* Linn. leaves. Biomedicine & Pharmacotherapy, 103: 1617-1622.

Begum, M.K.; Eshik, M.M.E.; Punom, N.J.; Abedin, M.M. and Rahman, M.S. (2018). Growth performances and bacterial load of *Heteropneustes fossilis* (Bloch, 1794) using cinnamon as feed supplement. Bangladesh Journal of Zoology, 46(2): 155-166.

Blomhoff, R. (2004). Antioxidants and oxidative stress. Tidsskrift for den Norske laegeforening: tidsskrift for praktisk medicin, ny raekke, 124(12): 1643-1645.

Castell, J.D. and Tiews, K. (1980). Report of the EIFAC, IUNS and ICES Working Group on Standardization of Methodology in Fish Nutrition Research, Hamburg, Federal Republic of Germany, 21-23 March 1979. Documents Techniques de la CECPI (FAO). IFAC tech. Pap.; 3(24).

Chang, S.T.; Chen, P.F. and Chang, S.C. (2001). Antibacterial activity of leaf essential oils and their constituents from Cinnamomum *osmophloeum*. Journal of ethnopharmacology, 77(1): 123-127.

Citarasu, T. (2010). Herbal biomedicines: a new opportunity for aquaculture industry. Aquaculture International, 18(3): 403-414.

Dawood, M.A. and Koshio, S. (2016). Recent advances in the role of probiotics and prebiotics in carp aquaculture: a review. Aquaculture, 454: 243-251.

Dedi, J.; Hutama, A.A.; Nurhayati, T. and Vinasyiam, A. (2016). Growth performance and flesh quality of common carp, *Cyprinus carpio* feeding on the diet supplemented with cinnamon (*Cinnamomum burmannii*) leaf. Aquaculture, Aquarium, Conservation & Legislation, 9(5): 937-943.

Duncan, C.B. (1955). Multiple rang and Multiple " F " test. Biometric, 11: 1-12.

FAO, Food and Agriculture Organization of the United Nations (1981). Report of the symposium on new developments in the utilization of the heated effluents in the circulation system for intensive aquaculture stavanger, 29-30, Rome. Italy.

Farsani, M.N.; Hoseinifar, S.H.; Rashidian, G.; Farsani, H.G.; Ashouri, G. and Van Doan, H. (2019). Dietary effects of *Coriandrum sativum* extract on growth performance, physiological and innate immune responses and resistance of rainbow trout (*Oncorhynchus mykiss*) against Yersinia ruckeri. Fish & shellfish immunology, 91: 233-240.

Gruenwald, J.; Freder, J. and Armbruester, N. (2010). Cinnamon and health. Critical reviews in food science and nutrition, 50(9): 822-834.

Hoseini, S.M.; Taheri Mirghaed, A. and Yousefi, M. (2019). Application of herbal anaesthetics in aquaculture. Reviews in Aquaculture, 11(3): 550-564.

Jayaprakasha, G.K. and Rao, L.J.M. (2011). Chemistry, biogenesis, and biological activities of *Cinnamomum zeylanicum*. Critical reviews in food science and nutrition, 51(6): 547-562.

Khan, A.; Safdar, M.; Khan, M.M.A.; Khattak, K.N. and Anderson, R.A. (2003). Cinnamon improves glucose and lipids of people with type 2 diabetes. Diabetes care, 26(12): 3215-3218.

Kim, S.H.; Hyun, S.H. and Choung, S.Y. (2006). Anti-diabetic effect of cinnamon extract on blood glucose in db/db mice. Journal of ethnopharmacology, 104(1-2): 119-123.

Kwon, H.K.; Jeon, W.K.; Hwang, J.S.; Lee, C.G.; So, J.S.; Park, J.A. and Im, S.H. (2009). Cinnamon extract suppresses tumor progression by modulating angiogenesis and the effector function of CD8+ T cells. Cancer letters, 278(2): 174-182.

Lin, C.C.; Wu, S.J.; Chang, C.H. and Ng, L.T. (2003). Antioxidant activity of *Cinnamomum cassia*. Phytotherapy Research, 17(7): 726-730.

Lopes, B.P.; Gaique, T.G.; Souza, L.L.; Paula, G.S.; Kluck, G.E.; Atella, G.C. and Pazos-Moura, C.C. (2015). Cinnamon extract improves the body composition and attenuates lipogenic processes in the liver and adipose tissue of rats. Food & function, 6(10): 3257-3265.

Matan, N.; Rimkeeree, H.; Mawson, A. J.; Chompreeda, P.; Haruthaithanasan, V. and Parker, M. (2006). Antimicrobial activity of cinnamon and clove oils under modified atmosphere conditions. International journal of food microbiology, 107(2): 180-185.

Mishra, A.K.; Mishra, A.; Kehri, H.K.; Sharma, B. and Pandey, A. K. (2009). Inhibitory activity of Indian spice plant *Cinnamomum zeylanicum* extracts against *Alternaria solani* and *Curvularia lunata*, the pathogenic dematiaceous moulds. Annals of Clinical Microbiology and Antimicrobials, 8(1): 9.

Mohammad, M.A. (2020). Effect of adding different levels of Chinese cinnamon (*cinnamomum* sp.) on growth rate and chemical composition criteria in common carp, *Cyprinus carpio* L. accepted for publishing in Iraqi Journal of verterinary Science.

Mohammad, M.A. (2017). Influence of Different Levels of Turmeric *Curcuma longa* and Red Paprika *Capsicum annum* L. Supplements on Growth Promoter and Chemical Composition of Common Carp *Cyprinus carpio* L. Jordan Journal of Agricultural Sciences, 13(1): 55-64.

Nagababu, E. and Lakshmaiah, N. (1992). Inhibitory effect of eugenol on non-enzymatic lipid peroxidation in rat liver mitochondria. Biochemical pharmacology, 43(11): 2393-2400.

NRC, National Research Council (2011). Nutrient requirements of fish and shrimp. Washington DC (US): National Academic Press, 392 pp.

Rahmawati, F.F. and Ubaidillah, M.F. (2017). The Effect Different Dossage of Cinnamomum Leaves (*Cinnamomum burmanni*) Supplementation on Growth and Survival Rate of Tilapia (*Oreochromis niloticus*). Aquacultura Indonesiana, 18(2): 62-66.

Raji, A.A.; Alaba, P.A.; Yusuf, H.; Bakar, N.H.A.; Taufek, N.M.; Muin, H. and Razak, S.A. (2018). Fishmeal replacement with *Spirulina Platensis* and *Chlorella vulgaris* in African catfish (*Clarias gariepinus*) diet: Effect on antioxidant enzyme activities and haematological parameters. *Research in veterinary science*, 119: 67-75.

Ren, H.; Jia, H.; Kim, S.; Maita, M.; Sato, S.; Yasui, M. and Hayashi, T. (2006). Effect of Chinese parsley *Coriandrum sativum* and chitosan on inhibiting the accumulation of cadmium in cultured rainbow trout *Oncorhynchus mykiss*. Fisheries Science, 72(2): 263-269.

Ricker, W.E. (1975). Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Borard Can.; 191, 1-382.

Rolin, F.; Setiawati, M. and Jusadi, D. (2015). Evaluasi pemberian ekstrak daun kayu manis *Cinnamomum burmannii* pada pakan terhadap kinerja pertumbuhan ikan patin *Pangasianodon hypophthalmus* Sauvage, 1878 [Evaluation of the addition of cinnamon *Cinnamomum burmannii* leaves extract in diet for growth performance of catfish *Pangasianodon hypophthalmus* Sauvage, 1878]. Jurnal Iktiologi Indonesia, 15(3): 201-208.

Sabitha K.; Venugopal B.; Rafi M.; Ramana K.V. (2014). Role of antioxidant enzymes in glucose and lipid metabolism in association with obesity and type 2 diabetes. American Journal of Medical Sciences and Medicine, 2(1): 21-24.

Sadıç, O. and Özcan, M. (2003). Antibacterial activity of Turkish spice hydrosols. *Food control*, 14(3): 141-143.

Salem, M.F.I.; Shehab, E.M.T.; Khalafallah, M.M.M.A.; Sayed, S.H. and Amal, S.H. (2010). Nutritional attempts to detoxify aflatoxic effects in diets of tilapia fish (*Oreochromis niloticus*). Journal of the Arabian Aquaculture Society, 5: 195-206.

Setiawati, M.; Jusadi, D.; Laheng, S.; Suprayudi, M.A. and Vinasyiam, A. (2016a). The enhancement of growth performance and feed efficiency of Asian catfish, *Pangasianodon hypophthalmus* fed on *Cinnamomum burmannii* leaf powder and extract as nutritional supplementation. Aquaculture, Aquarium, Conservation & Legislation, 9(6): 1301-1309.

Setiawati, M.; Jusadi, D.; Rolin, F. and Vinasyiam, A. (2016b). Evaluation of cinnamon *Cinnamomun burmannii* extract supplementation in diet on flesh fat content of catfish *Pangasianodon hypopthalmus*. Jurnal Akuakultur Indonesia, 15(2): 132-138. [in Indonesian].

Shan, B.; Cai, Y.Z.; Brooks, J.D. and Corke, H. (2009). Antibacterial and antioxidant effects of five spice and herb extracts as natural preservatives of raw pork. Journal of the Science of Food and Agriculture, 89(11): 1879-1885.

Sharififar, F.; Moshafi, M.H.; Dehghan-Nudehe, G.; Ameri, A.; Alishahi, F. and Pourhemati, A. (2009). Bioassay screening of the essential oil and various extracts from 4 spices medicinal plants. Pakistan journal of pharmaceutical sciences, 22(3): 317-322.

Singh, G.; Maurya, S.; DeLampasona, M.P. and Catalan, C.A. (2007). A comparison of chemical, antioxidant and antimicrobial studies of cinnamon leaf and bark volatile oils, oleoresins and their constituents. Food and chemical toxicology, 45(9): 1650-1661.

Sivagurunathan, A. and Innocent, B.X. (2014). Immunomodulatory effect of dietary cinnamon in growth and haematology of tilapia challenged with *Pseudomonas aeruginosa*. International journal of pharmaceutical and phytopharmacological research, 3(4): 277-280.

Song, S.K.; Beck, B.R.; Kim, D.; Park, J.; Kim, J.; Kim, H.D. and Ringø, E. (2014). Prebiotics as immunostimulants

in aquaculture: a review. Fish & shellfish immunology, 40(1): 40-48.

SPSS, Statistical Package for Social Science (2017). SPSS Version 25, SPSS Inc, U.S.A.

Starliper, C.E.; Ketola, H.G.; Noyes, A.D.; Schill, W.B.; Henson, F.G.; Chalupnicki, M.A. and Dittman, D.E. (2015). An investigation of the bactericidal activity of selected essential oils to *Aeromonas* spp. Journal of advanced research, 6(1): 89-97.

Stoyanova, S.; Zhelyazkov, G.; Sirakov, I.common, Velichkova, K. and Staykov, Y. (2018). Influence of dietary *Cinnamomum verum* extracton the growth and economic efficacy of common carp *Cyprinus carpio* L. reared in a recirculation system. Trakia Journal of Sciences, 16(4): 307-312.

Stuart, J.S. and Hung, S.S.O. (1989). Growth of juvenile white sturgeon (*Acipenser transmontanus*) fed different proteins. Aquaculture, 76(3-4): 303-316.

Takasao, N.; Tsuji-Naito, K.; Ishikura, S.; Tamura, A. and Akagawa, M. (2012). Cinnamon extract promotes type I collagen biosynthesis via activation of IGF-I signaling in human dermal fibroblasts. Journal of agricultural and food chemistry, 60(5): 1193-1200.

Talapatra, S.N.; Dasgupta, S.; Guha, G.; Auddy, M. and Mukhopadhyay, A. (2010). Therapeutic efficacies of *Coriandrum sativum* aqueous extract against metronidazole-induced genotoxicity in *Channa punctatus* peripheral erythrocytes. Food and chemical toxicology, 48(12): 3458-3461.

Vallejos-Vidal, E.; Reyes-López, F.; Teles, M. and MacKenzie, S. (2016). The response of fish to immunostimulant diets. Fish & shellfish immunology, 56: 34-69.

Verspohl, E.J.; Bauer, K. and Neddermann, E. (2005). Antidiabetic effect of *Cinnamomum cassia* and *Cinnamomum zeylanicum* in vivo and in vitro. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives, 19(3): 203-206.

Vinasyiam A.; Suprayudi M.A.; Alimuddin, (2016). Digestive enzymes activities in *Oreochromis niloticus* fed diet supplemented with recombinant growth hormone. Jurnal Akuakultur Indonesia, 15(1):15-23.

Volpe, M.G.; Monetta, M.; Di Stasio, M. and Paolucci, M. (2008). Rheological behavior of polysaccharide based pellets for crayfish feeding tested on growth in the crayfish *Cherax albidus*. Aquaculture, 274(2-4): 339-346.

Wei, A. and Shibamoto, T. (2007). Antioxidant activities and volatile constituents of various essential oils. Journal of agricultural and food chemistry, 55(5): 1737-1742.

Wong, Y.C.; Ahmad-Mudzaqqir, M.Y. and Wan-Nurdiyana, W.A. (2014). Extraction of essential oil from cinnamon (*Cinnamomum zeylanicum*). Oriental journal of chemistry, 30(1): 37-47.

Zehra, S. and Khan, M.A. (2012). Dietary protein requirement for fingerling *Channa punctatus* (Bloch): based on growth, feed conversion, protein retention and biochemical composition. Aquaculture International, 20(2): 383-395.