



## Effect of adding different levels of cinnamon (*Cinnamomum sp*) on growth and chemical composition criteria of common carp *Cyprinus carpio* L.

M.A. Mohammad 

Department of Animal production, College of Agriculture and Forestry, University of Mosul, Mosul, Iraq

### Article information

#### Article history:

Received December 04, 2019  
Accepted January 20, 2020  
Available online November 7, 2020

#### Keywords:

Common carp  
Cinnamon  
Darsin

#### Correspondence:

M.A. Mohammad  
[dr.mahmoud@uomosul.edu.iq](mailto:dr.mahmoud@uomosul.edu.iq)

### Abstract

This study was conducted to evaluate the addition of three levels of cinnamon (*Cinnamomum sp*), 96 common carp *Cyprinus carpio* L. at a mean weight of  $5 \pm 0.15$  g/fish on four experimental diets with three replicates per treatment 0% with three experimental diets containing 0.75%, 1%, and 1.5% of the total diet 2, 3 and 4 respectively. The results of the statistical analysis showed significant differences in the parameters of the total weight increase, daily growth rate, relative growth rate, protein intake, feed conversion ratio and protein productive value between the control diet and the fish feeding on the fourth diet, meanwhile there were no a significant difference in final weight, food intake, protein efficiency ratio criteria. Chemical body analysis revealed there were no a significant difference for dry weight, crude protein and ash, while cinnamon powder added have a significantly differences in body fat deposited. Based on the above results, 1.5% cinnamon can be added can improve the growth performance and nutritional value of common carp fish.

DOI: [10.33899/ijvs.2020.126362.1308](https://doi.org/10.33899/ijvs.2020.126362.1308), ©2021, College of Veterinary Medicine, University of Mosul.  
This is an open access article under the CC BY 4.0 license (<http://creativecommons.org/licenses/by/4.0/>).

### Introduction

The aquaculture production in fresh water in Iraq is estimated at 24.6 thousand tons in 2014, which constitutes up to 28% of the total national production of natural fisheries, which amounted to 63 thousand tons. The common carp, grass, and silver come in the forefront of these fish, the hatchery is estimated at about 17 million, with its production of fry reaching 65 million carp per year, and the number of fish feed factory reaching 17, with a production capacity of 43,000 tons which included cage culture methods as intensive culture system and earthen pond (1).

The intensification of fish culture in the area unit has led to problems in the spread of diseases and deterioration of water quality, causing increased stress and diseases to inhibit growth, which necessitated the use of antibiotics extensively in animal production fields, including fish

ponds to control these, which lead to increased growth and the efficiency of food utilization, but the excessive use of these antibiotics led to the emergence of bacterial bacterium resistant to these antibiotics and most of them have a wide spectrum on many microorganisms, which damage some beneficial species present in microflora are intestines and have a negative effect on the risks of their cumulative effect on meat consumed by humans (2). By the European Union in January 2006, in which the use of antibiotics was prevented from increasing growth within livestock sector. This led fish workers to study the content of the intestinal zone of warm and cold marine fish to identify beneficial (3). This led researchers to seek the use of old medicine in terms of the use of medicinal herbs because of their ability to improve public health and its side effects. *Cinnamomum zeylanicum* has been used for thousands of years for medicinal purposes such as analgesics, antiseptics, antispasmodics, and parasite. There have been few

published studies on the effect of this plant in the field of aquaculture, as well as its effects on blood sugar and antioxidant (4) and its effect as an antibacterial agent, and its effects on cytotoxicity (5) and on the growth of common carp fish (6) Asian catfish *Hypophthalmus pangasianodon* (7) and Nile tilapia *Oreochromis niloticus* (8).

**Materials and methods**

This research was carried out in Fish Laboratory of the Animal Production Department, College of Agriculture and Forestry, University of Mosul for eight weeks from 22/5/2018 to 16/7/2018. 27 glass aquaria with dimensions 40\*60\*40 cm. fish were obtained from Yankee hatchery, Ministry of Agriculture, Iraq.

A total of 96 common carp were distributed on 12 glass aquaria with an initial weight 5±1 g / fish and six fish/aquaria with three replicates for each treatment. Fish were adapted to an aquaria environment and diet for four weeks. Fish fed at 3% of its wet body weight throughout the research period. The aquaria were provided with water after they were placed in a large tank without a lid inside the laboratory for 24 hours to get rid of chlorine as well as

obtaining suitable temperature of water with by using three air conditioners. Disposal of solid waste excreted of fish by using siphon was replaced about 20% -25% of the amount of water found in aquarium a day with pure water. A field instrument was used to measure dissolved oxygen, which was 5.7-6.8 mg /l throughout the duration of the experiment. These parameters fall within the appropriate limits for warm-water fish growth of 25-30°C and 3-7mg/L of temperature and dissolved oxygen, respectively (9), and the pH was 7.2-8.6, measured by a HANNA pH meter at room temperature and this parameter within the limits recommended by (2). Four experimental diets were synthesized containing 25.42% crude protein and 13.17 MJ / kg of feed representing, containing three levels of Chinese cinnamon powder 0.75%, 1% and 1.5%, which were purchased from markets, as well as a control diet (free of cinnamon powder). Common carp fish were fed on four experimental diets and their components and chemical composition were shown in Table 1. The components of experimental diets and edible fish were analyzed based on the standard methods described above, depending on the methods described by (10).

Table 1: Dietary ingredients and chemical composition (%) of the diets containing different percentages of Cinnamon powder

Ingredients	Control (1)	Cinnamon 0.75% (2)	Cinnamon 1.00% (3)	Cinnamon 1.50% (4)	
Cinnamon powder	-	0.75	1	1.5	
Animal protein	10	10	10	10	
Soybean meal	30	30	30	30	
Local barley	20	20	20	20	
Yellow corn	18.5	18.5	18.5	18.5	
Wheat bran	19	19	19	19	
Food salt	1	1	1	1	
Vit. & Miner. Mix.	0.5	0.5	0.5	0.5	
Lime stone	0.5	0.5	0.5	0.5	
binder (Pentolite)	0.5	0.5	0.5	0.5	
<b>Chemical composition</b>					
Crude protein	Ether extract	Ash	Crude fiber	Nitrogen free extract	ME (MJ/Kg)
25.45	3.54	6.97	4.75	52.2	13.17

Calculated according to Smith's equation: ME(MJ/Kg) = Protein X 18,8 + Fat X 33,5 + NFE X13,8 (11).

The following criteria were used to demonstrate the effect of adding cinnamon at different levels to the scales: Weight Gain (Weight Gain), Growth Rate, Relative Growth Rate (RGR), Specific Growth Rate growth rate (SGR), Food Conversion Ratio (FCR), Feed Efficiency Ratio (FER) And Protein Efficiency Ratio (PER) and Protein Productive Value (PPV), according to the following equations: Growth daily gain= [(Wt-Wo) / t], where Wt is final weight of fish (g) and Wo = Initial weight of fish (g), t = time (day). Initial and final weights (IW and FW, respectively) were taken into account for calculation of specific growth rate and relative growth rate with formula: SGR (%) = ln FW-ln IW / time (day) × 100, RGR= FW-IW

/ IW × 100, food Conversion Ratio = g dry feed intake/g wet weight and PER weight gain/g apparent protein intake/g. Protein Productive Value = protein in final wt(g) - Initial wt / Protein intake(g)× 100 and Survival Rate=Number of dead fish / Total number of fish × 100.

All data were analyzed and performed with SPSS software release 6.0 for windows. Data are given as mean±standard error of mean of three replicates of pooled samples. Data were subjected to one-way analysis of variance. Duncan's new multiple range test were used to determine differences among means for criteria. Significant differences were performed at P<0.05.

## Results

### Final weight, weight gain and daily weight gain

Results of the statistical analysis of the growth criteria studied in table 2, showed no significant differences. Among the studied the primary weight criterion, which was 5,26 g/fish, table 2 shows that the highest final fish weight (gm/fish) was 9,86 for fish fed on the 4<sup>th</sup> diet 1.5% cinnamon, while the lowest value for fish fed on the control diet (zero cinnamon) was 8.53, these differences was not significantly. In addition, the results indicated that weight gain increased by adding 1% and 1.5% cinnamon powder (diet 3 and 4) had a positive effect on the results, which was 4,44, 4,54 respectively, meanwhile fish fed on control diet recorded 3.33 g/fish. This improvement in growth was due to the addition of cinnamon powder.

### Relative growth and specific growth rate

Table 3 shows that fish fed on diets 3 and 4 82.59 % and 84.24 % differed significantly ( $P>0.05$ ) with control diet 64.39%, when cinnamon was added by 1% and 1.5%.

### Feed intake and feed conversion ratio

Table 4 shows that there is no significant difference between the fish fed on control diet and the fish fed on the

diet containing cinnamon at different rates for the daily and total feed intake. The value these criteria increase with directly with the increase in the addition of cinnamon. The data recorded in the table 4, best feed conversion ratio was for fish feeding on the 2<sup>nd</sup> diet which was significantly higher than control diet and fish fed at the 3<sup>rd</sup> diet. It is noted from the same table that diets containing different percentages of cinnamon also differed significantly with control diet in these criteria.

### Protein intake and protein efficiency ratio

Table 5 shows that the best food intake was for fish fed on the fourth diet which was significantly higher than the fish fed on the second diet container of 0.75% cinnamon powder, while no significant differences were recorded with the fish fed on the third diet. This results in the context of the high appetite of fish to eat feed for the qualities possessed by cinnamon, which was discussed earlier, as the results of statistical analysis of the criterion of protein efficiency ratio (PER) to the existence of significant differences between the various transactions, which amounted to 1.52, 1.48 and 1.43 for the second, third and fourth diets respectively, while the mean value of the control diet was 1.43.

Table 2: Effect of Cinnamon powder on final weight, weight gain, and daily growth rate criteria of common carp (g/fish)

Diets	Initial body weight	Final body weight	Total weight gain	Daily weight gain
Control	0.02±0.06 b	3.33±0.28 b	8.53±0.72 a	5.20±0.44 a
0.75% Cinnamon	0.07±0.018 ab	3.89±0.24 ab	9.12±0.51 a	5.22±0.29 a
1.00% Cinnamon	0.079±0.28 a*	4.44±0.37 a	9.72±0.72 a	5.28±0.35 a
1.50% Cinnamon	1.81±0.025 a	4.54±0.33 a	9.86±0.67 a	5.32±0.33 a

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

Table 3: Effect of Cinnamon powder on relative and specific growth rate and survival rate criteria of common carp

Diets	Relative growth weight (%)	Specific growth rate (SGR)	Survival rate (%)
Control	64.39±1.48 c	0.89±0.04 a	100
0.75% Cinnamon	75.03±2.76 b	0.94±0.02 a	100
1.00% Cinnamon	82.59±1.72 a	0.95±0.02 a	100
1.50% Cinnamon	84.24±1.83 a	0.96±0.03 a	100

\*Means not sharing a common superscript letter are significantly differences  $P<0.05$ .

### Protein deposition, ash and fat

The results of the statistical analysis of the protein (gm/fish) showed significant differences between fish fed on different diets. Data recorded in table 4 indicate that the percentage of protein deposited directly with percentage additive of cinnamon, so, protein retention of 4<sup>th</sup> diet 0.81, which increased significantly with control diet 0.51.

Our current study of protein productive value criterion, where fish fed cinnamon powder at different levels 0.75, 1 and 1.5% was significantly higher than control diet which was 26.04, 27.33, 31.17% and 23.58% for diets 2, 3, 4 and

1 respectively. Results of the effect of cinnamon on chemical composition of body of common carp fed at different percentages of China cinnamon powder referred the absence of any significant differences ( $P> 0,05$ ) in percentage of dry matter, which ranged from 26.81% of fish fed on the control diet, while 27.77%, 26.95 and 27.10% for fish fed at 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> diets respectively. As well as for the percentage of crude protein 15.11% (control diet) and 15.25% for fish fed at the 3<sup>rd</sup> diet 1% cinnamon powder. There were no significant differences in the percentage of ash in our current study, which increased but not

significantly with the addition of cinnamon as it reached 3.19% (control diet) and 3.83% for fish fed on the 4<sup>th</sup> diet.

Table (6) shows that the addition of cinnamon reduced fat content of the fish body. Fat content was significantly

reduced ( $P > 0.05$ ) in the edible portion of fish feeding on diets containing 1 and 1.5, with fat percentage of 7.78% and 7.65% respectively, while fish fed on the control diet reached to 8.81%.

Table 4: Effect of Cinnamon powder on feed intake, feed conversion ratio of common carp

Diets	Food intake (gm/fish)	Food intake (gm/fish/day)	Food conversion ratio
Control	9.99±1.06 a	0.012±0.040 a	3.34±0.190 a
0.75% Cinnamon	9.81 ±0.68 a	0.018±0.012 a	2.22±0.044 c
1.00% Cinnamon	11.43 ±1.04 a	0.021±0.020 a	2.75±0.078 b
1.50% Cinnamon	15.09±2.34 a	0.085±0.080 a	2.86±0.062 b

\*Means not sharing a common superscript letter are significantly differences at  $P < 0.05$ .

Table 5: Effect of Cinnamon powder on protein intake, protein efficiency ratio, protein deposition and protein productive value criteria of common carp

Diets	Protein consumption (gm/f/d)	Protein efficiency ratio (PER)	Protein retention (gm/fish)	Protein Productive Value (PPV)
Control	2.53±2.7 b	1.48±0.107	0.51±0.03 b	23.58±4.30 b
0.75% Cinnamon	2.49±1.47 b	1.52±0.10	0.59±0.02 ab	26.04±1.80 a
1.00% Cinnamon	2.90±0.26 ab	1.43±0.03	0.63±0.05 a	27.33±2.77 a
1.50% Cinnamon	3.82±0.59 a	1.40±0.09	0.81±0.13 a	31.17±2.92 a

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

Table 6: Chemical composition (%) of the edible common carp fed to different percentages of Cinnamon

Diets	Dry weight	Total protein	Ether extract	Ash
Control	26.81±0.06 a	15.11±0.16 a	8.81±0.21 a	3.19±0.48 a
0.75% Cinnamon	27.77±0.62 a	15.10±0.29 a	8.16±0.09 ab	3.40±0.15 a
1.00% Cinnamon	26.95±1.63 a	15.25±0.10 a	7.78±0.34 b	3.31±0.05 a
1.50% Cinnamon	27.01±0.06 a	15.21±0.06 a	7.65±0.33 b	3.83±0.17 a

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

## Discussion

The results of this research show that common carp fed on a diet containing 1% cinnamon powder had positive effects in growth and food utilization criteria. The addition of cinnamon powder by 0.75% resulted in an improvement in growth criteria and survival rate. Growth of common carp in our current research may be due to cinnamon containing growth enhancers. (12) found that cinnamon leaves contain growth promoters, trans-cinnamaldehyde, eugenol and cummarin, while (13) did not have significant differences in growth rates of common carp, but computed when adding cinnamon extract showed significant differences for the final weight and weight gain values.

These two criteria are used to evaluate fish growth over other growth parameters. Relative growth rate expresses growth performance regardless of initial weight. Specific growth rate reduces the dispersion of experimental units by adopting the natural logarithm of comparison between experimental units under study (9).

These results were consistent with (14) adding cinnamon powder by 0.25% to 1% Cinnamon leaves have improved growth and survival rate of common carp, as well as Abdel-Tawwab *et al.* (15). The addition of cinnamon powder has enhanced the secretion of digestive enzymes, protease, lipase, fungal immunity, amylase. It may enhance the community of beneficial microorganisms, or may promote microbial enzymes that improve feed digestion and nutrient uptake, enhanced the activity of digestive enzymes as well as innate immunity. Both Ahmad *et al.* (8), Sivagurunathan *et al.* (16), Stoyanova *et al.* (13) did not have significant differences in growth rates of common carp fish, but were computed when adding cinnamon extract showed significant differences for the relative growth rate and specific growth rate compared with control diet when adding Chinese cinnamon powder at percentage 2.5%. The researchers obtained fewer effective results on these criteria. Setiawati *et al.* (7) found significant differences in specific growth rate criteria, when adding 1% cinnamon leaf extract, leave powder to an Asian catfish diet.

Feed intake and feed conversion ratio are important criteria that indicate the quality of food provided fish farms. The data shows that there is no significant difference between the fish fed on control diet and fish fed on diet containing cinnamon at different rates for daily and total feed intake. It was found that eating cinnamon reduces the rate of emptying digestive system with lowering blood sugar (17), and may be associated with the smell of cinnamon distinctive, where Dedi *et al.* (14) reported that eating feed that contains cinnamon causes an increase in the fish's appetite for eating the feed, because cinnamon contains oil up to 10-12%, which contains cinnamaldehyde (14), while Abdul-Tawwab (15) was not obtain significant differences when adding cinnamon by 3% to 10% to the diet of Nile tilapia. Data indicated that in the table (4), the best dietary conversion ratio was for fish feeding on 2<sup>nd</sup> diet which was significantly higher than control and 3<sup>rd</sup> diet. It is noted from the same table that diets containing different percentages of cinnamon, also differed significantly with control diet in these criteria. These results are consistent with the findings of many researchers, where Al-Ashaab *et al.* (6) reported that, the addition of Chinese cinnamon by 1% resulted in a higher significantly for dietary conversion ratio and feed efficiency, meanwhile Abdul-Tawwab *et al.* (15) had significant differences when addition cinnamon by 0.25% to 10% of the total diet. Setiawati *et al.* (7) found significant differences, in addition of cinnamon powder and extract leaves in feeding efficiency criterion of Asian catfish.

The nutritional importance of protein efficiency ratio and protein productive value is concentrated in the interpretation of protein pathways used to build protein, fatty tissues, or that weight gain is due to increased moisture. Results of protein intake correlated with the amount of feed intake, where the results of the current research show an increase in amount of protein intake of fish fed on fourth diet containing 1.5% cinnamon. This results in the strong appetite of fish to consume food for the consistency of cinnamon. There were no significant differences between the fish fed on the other experimental diets of protein efficiency ratio criterion. These results are consistent with the findings of Al-Ashaab *et al.* (6) that the addition of 1% cinnamon powder produced significant differences in protein intake.

The aim of the use of food additives in experimental diets, including medicinal herbs, including cinnamon, is to enhance the growth of fish by growing the proportion of protein in fish tissue fed on such promoters of growth rather than by fat deposition. Evidenced of the effects of this high protein content deposited directly proportional to the high rate of addition of cinnamon. Satawati *et al.* (7), Rolen *et al.* (18), noted increased the protein deposition in the Asian catfish when cinnamon leaf extract was added by 0.1 per cent and 1 per cent of powder leaf, respectively, and this was attributable to the growth impact Cinnamaldehyde was

the key component of cinnamon, which reached 60.72% (12,18) of which the addition of leaves extract was noted of cinnamon improve the value of protein retention, when adding by 1g/ kg compared with control.

The results of the addition of different levels of cinnamon powder showed that it was positive in improving the protein productive value of fish fed on these experimental diets, which recorded significant differences compared to the fish fed on the control diet. No significant differences were observed in the chemical composition of the fish fed with different proportions of cinnamon powder, which included dry matter, crude protein and ash. Although there were significant differences in the level of ether extract, which decreased significantly for fish fed on the diet containing cinnamon by 1 and 1.5% (diet 3 and 4). While Takasao *et al.* (19) found high protein content in the body of fish, they indicated that cinnamon has the ability to stimulate growth by enhancing protein and collagen biosynthesis in body tissues. This result did not agree with the conclusion of Rolen *et al.* (18) who found that intake 1% of cinnamon extracts in the Asian catfish has a significant effect in increasing the deposition of protein. While Abdel-Tawwab (15) reported that the ash content in the body of Nile tilapia was increased significantly, when using nanotechnology to treat cinnamon. We assume that this difference may be due to the cinnamon variety, its processing technology extracts and the fish class being tested.

In the present research, the addition of cinnamon powder to the diet of the third and fourth fish significantly decreased the amount of fat in the edible portion compared with the control diet. Hlebowicz (17) stated that low body fat is associated with low blood glucose, which is associated with a high gastric emptying rate, Azima (20), Meanwhile, Abdel Tawwab (15) did not find significant differences due to adding cinnamon to the Nile tilapia diet.

## **Conclusion**

The results of current study demonstrated that the addition of 1.50 per cent cinnamon to the fish diet would improve the growth rate also improve the feed conversion ratio, in addition to reduction in total fat percentage in edible portion of the fish.

## **Conflict of interests**

Authors declares that they have no conflict of interest regarding publishing this article.

## **Acknowledgement**

The researcher wishes to thank the University of Mosul and the College of Agriculture and Forestry for their support and provide the requirements for the completion of this research.

## References

1. Arab Organization for Agriculture Development (AOAD). Arab Strategy for Agricultural Development 2017-2037. Sudan: League of Arab States, Republic of Sudan; 2002. 44 p. [\[available here\]](#)
2. Al-Mashhadany, DA. Monitoring of antibiotic residues among sheep meat in Erbil city and thermal processing effect on their remnant. Iraqi J Vet Sci. 2020;34(2):217-222. Doi: [10.33899/ijvs.2019.125814.1161](#)
3. Ringo E, Sperstad S, Myklebust R, Refstie S, Krogdahl A. Characterization of the microbiota associated with intestine of Atlantic cod *Gadus morhua* L. the effect of fish meal, standard soybean meal and a bioprocessed soybean meal. Aquacul. 2006;261:829-841. Doi: [10.1016/j.aquaculture.2006.06.030](#)
4. Lin CC, Wu SJ, Chang CH, Ng LT. Antioxidant activity of *Cinnamomum cassia*. Phototherap Res. 2003;17(7):726-30. <http://dio.org/> [10.1002/ptr.1190](#).
5. Pathirana, HNKS, Wimalasena, SHMP, De Silva, BCJ, Hossain SJ. Antibacterial activity of cinnamon *Cinnamomum zeylanicum* essential oil and cinnamaldehyde against fish pathogenic bacteria isolated from cultured olive flounder *Paralichthys olivaceus*. Indian J Fish. 2019;66(2): 86-92. Doi: [10.21077/ijf.2019.66.2.85023-12](#)
6. Al-Hadedi, AA. Effect of using Anise and cinnamon in common carp *Cyprinus carpio* L. diets on the growth and physiological characteristic [master's thesis]. Diyala: College of Agriculture, Department of Animal production, University of Diyala; 2016. 54 p. [\[available here\]](#)
7. Setiawati M, Jusadi D, Laheng S, Suprayudi AM, Vinasiam A. The enhancement of growth performance and feed efficiency of Asian catfish, *Pangasianodon hypophthalmus* fed on *Cinnamomum burmannii* leaf powder and extract as nutritional supplementation. Legis J Bioflux Soc. 2016;9(6):1301-1309. [\[available here\]](#)
8. Ahmad MH, El Mesallamy AMD, Samir F, Zahran F. Effect of cinnamon (*Cinnamomum zeylanicum*) on growth performance, feed utilization, whole-body composition, and resistance to *Aeromonas hydrophila* in Nile tilapia. J Appl Aqua. 2011;23:289-298. Doi: [10.1080/10454438.2011.626350](#)
9. Hopher B. Nutrition of pond fish. London: Cambridge University Press; 1988. 27 p. Doi: [10.1017/CBO9780511735455](#)
10. Association of Official Analytical Chemists (AOAC), 17<sup>th</sup> ed. Washington: Princesed; 2007. 125-291 p. [\[available here\]](#)
11. Smith RG. A method for measuring digestibility and metabolizable energy of feeds. Prog Fish Cult. 1971;33:132-134. Doi: [10.1577/1548-8640](#)
12. Wang R, Wang R, Yang B. Extraction of essential oils from five cinnamon leaves and identification of their volatile compound compositions. Innov Food Sci Emerg Technol. 2009;10:289-292. Doi: [10.1016/j.ifset.2008.12.002](#)
13. Stoyanova S, Zhelyazkov G, Sirakov I, Velichkova K, Staykov Y. Influence of dietary *Cinnamomum verum* extract on the growth and economic efficiency of common carp *Cyprinus carpio* L. reared in a recirculation system. Turakia J Sci. 2019;(4):307-312. Doi: [10.15547/tjs.2018.04.007](#)
14. Dedi J, Arief AH, Nurhayati T, Wasjan A. Growth performance and flesh quality of common carp, *Cyprinus carpio* feeding on the diet supplemented with cinnamon *Cinnamomum burmannii* leaf. Inter J Bioflux Soc. 2016;9:937-943. [\[available here\]](#)
15. Abdel-Tawwab M, Samir F, Asmaa S, Abd El-Naby MNM. 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 Immunol. 2018;74:19-25. Doi: [10.1016/j.fsi.2017.12.033](#)
16. Mohammad HA, Amani MD, El-Mesallamy FZ. Effect of cinnamon (*Cinnamomum zeylanicum*) on growth performance, feed utilization, whole-body composition, and resistance to *Aeromonas hydrophila* in Nile tilapia. J Appl Aquacul. 2011;23(4):289-298. Doi: [10.1080/10454438.2011.626350](#)
17. Hlebowicz J, Darwiche G, Bjorgell O, Almer LO. Effect of cinnamon on postprandial blood glucose, gastric emptying and satiety in healthy subjects. Am J Clin Nutr. 2007;85:1552-1556. Doi: [10.1093/ajcn/85.6.1552](#)
18. Rolin F, Setiawati M, Jusadi D. Evaluation of the addition of cinnamon *Cinnamomum burmannii* leaves extract in diet for growth performance of catfish *Pangasianodon hypophthalmus* Sauvage, 1878. Indonesian J Ichthyol. 2017;15(3):201-208. Doi: [10.32491/jii.v15i3.56](#)
19. Takasao N, Tsuji K, Ishikura S, Tamura A, Akagawa M. Cinnamon extract promotes type I collagen biosynthesis via activation of IGF-I signaling in human dermal fibroblasts. J Agri Food Chem. 2012;60:1193-1200. Doi: [10.1021/nl0728874 pmid:18189442](#)
20. Azima F. Antioxidant and anti-platelet aggregation activities of cassia vera (*Cinnamomum burmannii*) bark extract and its potency in preventing atherosclerosis in rabbit [PhD dissertation]. Bogor: Graduate School, Bogor Agricultural University; 2004. 122 p. [\[available here\]](#)

## تأثير إضافة مستويات مختلفة من القرفة (*Cinnamomum* sp) على معايير النمو والتركيب الكيميائي لأسماك الكارب الشائع *Cyprinus carpio* L.

محمود احمد محمد

قسم الثروة الحيوانية، كلية الزراعة والغابات، جامعة الموصل، الموصل، العراق

### الخلاصة

أجري هذا البحث لغرض تقييم إضافة ثلاث مستويات من القرفة، وزعت عشوائياً ٩٦ سمكة كارب شائع، بمعدل وزن  $105 \pm 0.0$  غم/سمكة على أربعة علائق تجريبية بواقع ثلاث مكررات لكل معاملة والتي احتوت على نسب مختلفة من هذه الأعشاب الطبية الى عليقة المقارنة، وهي صفرة % (عليقة ١) وثلاث علائق تجريبية احتوت على ٠,٧٥% و ١% و ١,٥% من العليقة الكلية عليقة ٢ و ٣ و ٤ على التوالي. بينت نتائج التحليل الإحصائي وجود فروق معنوية في معايير الزيادة الوزنية الكلية ومعدل النمو اليومي ومعدل النمو النسبي والبروتين المتناول ومعامل التحويل الغذائي والبروتين المترسب والقيمة المنتجة للبروتين ما بين عليقة المقارنة والأسماك المغذاة على العليقة الرابعة، بينما لم تسجل فروق معنوية مع الأسماك المغذاة على عليقة السيطرة معايير الوزن النهائي والنمو اليومي والنمو النوعي والغذاء المتناول ونسبة كفاءة البروتين ومكونات جسم الأسماك من المادة الجافة والبروتين الخام والرماد، بينما أدى إضافة مسحوق القرفة الى خفض معنوي لنسبة الدهون المترسبة في الجسم. بناءً على النتائج المذكورة آنفاً فإنه بالإمكان إضافة ١,٥% من القرفة (الدارسين) لغرض تحسين أداء النمو والقيمة الغذائية لأسماك الكارب الشائع.