

Research Article



Implications for Carcass, Lymphatic Organs, and Liver Enzyme Quality Following Supplementation of Drinking Water with Aqueous and Alcoholic Extracts of Iraqi Jasmine Leaves (*Lonicera japonica* L.)

NAJEH JABIR AL-SHEMERY¹, NIHAD ABDUL-LATEEF ALI¹, BUSHRA. S.R. ZANGANA², SABAH M. AL-SHATTY³, AHMED F. KADHIM⁴, NASRALLAH RADHI MISJEL⁵, ALI SHAMKHI JABBAR⁶, ELAF H. AL-JUMAILI^{1*}, MOHAMMED S. EUKAAL⁶

¹Department of Animal Production, College of Agriculture, Al-Qasim Green University, Iraq; ²College of Agriculture Engineering Sciences, University of Baghdad, Baghdad, Iraq; ³Department of Food Sciences, College of Agriculture, University of Basrah, Iraq; ⁴College of Nursing, University of Thi Qar, Iraq; ⁵College of Physical Education and Sport Science, University of Thi-Qar, Iraq; ⁶Department of Animal Production, College of Agriculture, University of Wasit, Kut, Wasit, Iraq.

Abstract | This experiment was conducted at Al-Anwar Poultry Company, Babil Governorate, to evaluate the effects of supplementing drinking water with aqueous and alcoholic extracts of Iraqi jasmine leaves (*Lonicera japonica* L.) on carcass traits, lymphoid organs, and selected liver enzymes in broiler chickens (Ross 308). A total of seven treatments were randomly assigned, each comprising three replicates with 10 birds per replicate. Birds were reared for 35 days under floor housing conditions. The treatments included a control group (no supplementation), three groups receiving aqueous extract of Iraqi jasmine leaves at 10 ml/L of drinking water with concentrations of 15%, 30%, and 45%, and three groups receiving alcoholic extract of Iraqi jasmine leaves at the same dose (10 ml/L) with concentrations of 15%, 30%, and 45%. The results indicated that the control group showed a significantly higher relative weight of the drumstick compared to other treatments. The fourth treatment (aqueous extract at 45%) exhibited the highest ($P \leq 0.05$) relative weight of the back portion, while fifth treatment (alcoholic extract at 15%) showed the highest ($P \leq 0.05$) relative weight of neck portion. No significant differences were observed among treatments in lymphoid organ parameters, including the relative weight and index of the bursa of Fabricius and the relative weight of the spleen. A significant reduction ($P \leq 0.05$) in aspartate aminotransferase (AST) levels was observed in all supplemented groups compared to the control. Additionally, alanine aminotransferase (ALT) levels were significantly reduced ($P \leq 0.05$) in the fourth, sixth, and seventh treatments. However, no significant changes were detected in alkaline phosphatase (ALP) levels among all treatments. In conclusion, supplementation with aqueous and alcoholic extracts of *Lonicera japonica* leaves influenced certain carcass traits and liver enzyme activities without affecting lymphoid organ development.

Keywords | Iraqi Jasmine, *Lonicera japonica* L., Alcoholic extract, Lymphoid organ, Liver enzymes

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***Correspondence** | Elaf H. Al-Jumaili, Department of Animal Production, College of Agriculture, Al-Qasim Green University, Iraq; **Email:** elaf@agre.uoqasim.edu.iq

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The poultry industry is one of the main sources upon which humans rely, as it provides protein-rich meat and eggs. Demand for these products has increased due to rising human income (FAO, 2019). The global poultry industry has witnessed remarkable and widespread development in recent years, both in meat and egg production. The volume of meat production has increased compared to other animal products, and its growth rate has exceeded that of egg production (Windhorst, 2006). In recent years, the poultry industry has increasingly adopted functional feeding strategies aimed at improving productivity, health status, and metabolic efficiency in birds. These strategies include the use of natural and nano-biological feed additives, which have shown promising effects in enhancing growth performance and egg production in laying hens. Such approaches represent an advanced trend toward sustainable and efficient poultry production systems (Abaas *et al.*, 2026).

This development has been accompanied by the expanded use of various feed additives to enhance productivity, including organic acids, enzymes, herbs, and medicinal plants. These additives are valued for their natural chemical constituents, which have significant therapeutic and physiological benefits (Al-Jarallah, 2001), as well as their content of minerals and vitamins, such as vitamins C and E, which play a major role in strengthening the immune system and reducing oxidative stress in birds (Sahin *et al.*, 2003). One important medicinal plant is Iraqi jasmine (*Lonicera japonica* L.), an aromatic species found in East Asia, including Japan, Korea, and northeastern China (CONP, 2005; Farhat *et al.*, 2011), as well as in other regions of the world (Passalacqua *et al.*, 2007). It is an evergreen plant belonging to the family Oleaceae.

This plant is widely used in medical applications due to its broad range of biological and pharmacological properties. Its bioactive compounds exhibit antioxidant and anti-inflammatory effects (Hsu *et al.*, 2016; Al-Rekabi *et al.*, 2020), as well as lipid-lowering, antibacterial, antiviral, antipyretic, and antitoxic activities (Shang *et al.*, 2011; Hammoud *et al.*, 2018). The growing interest in natural antimicrobial compounds has encouraged the development of biologically derived alternatives for use in animal production systems. Recent studies have demonstrated that natural antibacterial agents can be produced from poultry-derived organic materials combined with medicinal plant sources, highlighting their potential role in improving animal health and reducing dependence on conventional antimicrobials (Al-Salhi *et al.*, 2025a). These findings further support the investigation of plant-based extracts such as *Lonicera japonica* as promising natural additives in poultry production.

Jasmine also contains essential oils, commonly referred to as jasmine oil (Jasmine perfume). The compounds responsible for its fragrance include benzyl acetate, benzyl alcohol, and linalool (Alloush and Salman, 2016). The plant is rich in essential oils, organic acids, flavonoids, saponins, and inorganic elements. Among its key constituents is chlorogenic acid, a biologically active compound with notable pharmacological effects, which is present in high concentrations in the leaves (Mustak *et al.*, 2015).

Therefore, the present study was conducted to evaluate the effects of supplementing broiler drinking water with aqueous and alcoholic extracts of Iraqi jasmine leaves (*Lonicera japonica* L.) at different concentrations on carcass characteristics, relative weights of lymphoid organs, and selected serum liver enzyme activities (AST, ALT, and ALP). The findings are expected to provide further evidence regarding the potential of *L. japonica* as a natural phyto-genic additive for improving physiological responses and production traits in broiler chickens.

MATERIALS AND METHODS

PREPARATION OF THE AQUEOUS AND ALCOHOLIC EXTRACTS OF IRAQI JASMINE LEAVES

The aqueous and alcoholic extracts of Iraqi jasmine (*Lonicera japonica* L.) leaves were prepared in the laboratories of the College of Agriculture, Al-Qasim Green University. Fresh plant material was obtained from local markets. The leaves were separated from the stems, washed with distilled water, and dried in an electric oven at 30 °C until completely dehydrated. The dried leaves were then ground using an electric mill to obtain a homogeneous powder, which was sieved through a fine mesh (0.5 mm). The resulting powder was stored in sterile, clean glass containers and kept refrigerated until use. The aqueous extract was prepared according to the method described by Shtayeh and Abu-Ghdeib (1999), while the alcoholic extract was prepared following Rahman and Kang (2009).

FLOCK MANAGEMENT

A total of 210 unsexed broiler chicks (Ross 308) were obtained from Al-Anwar Hatchery in Babil Governorate. The average initial body weight of the chicks was 39 g per bird. The chicks were randomly allocated into seven treatments, with three replicates per treatment and 10 birds per replicate. The birds were reared under standard management conditions in a floor housing system for 35 days.

The chicks were fed ad libitum throughout the experimental period. A starter diet (1–10 days) containing 2940 kcal/kg metabolizable energy (ME) and 21.94% crude protein (CP), a grower diet (11–21 days) containing 2995 kcal/kg ME

and 19.66% CP, and a finisher diet (22–35 days) containing 3035 kcal/kg ME and 18.29% CP were provided, according to [NRC \(1994\)](#) recommendations. Feed ingredients were sourced from local markets and processed at Al-Ghadeer Feed Factory in Babil Governorate. The composition of the experimental diets is presented in [Table 1](#).

The experimental treatments were as follows: the first treatment served as the control group with no supplementation in drinking water. The second, third, and fourth treatments received aqueous extract of jasmine leaves at a rate of 10 ml/L of drinking water with concentrations of 15%, 30%, and 45%, respectively. The fifth, sixth, and seventh treatments received alcoholic extract at the same rate (10 ml/L) with concentrations of 15%, 30%, and 45%, respectively.

Table 1: Percentages of feed materials used in the rations of the experiment with chemical composition.

Components	Types of rations**		
	Starter (1-10 days)	Growth (11-21 days)	Final (22-35 days)
Yellow corn	52.8	58.65	62.4
Wheat	10	10	10
Protein concentrate *	5	5	5
Soybean meal (48 %)	29.8	24	20.5
Sunflower oil	0.3	0.3	0.3
Dicalcium and phosphorous	0.5	0.35	0.2
Limestone	1.14	1.21	1.22
Methionine	0.17	0.17	0.13
Lysine	0.19	0.22	0.15
Table salt	0.1	0.1	0.1
Total	100	100	100
Calculated chemical composition			
Metabolisable energy (kcal / kg feed)	2940	2995	3035
Crude protein (%)	21.94	19.66	18.29
Methionine + Cysteine (%)	1.03	0.97	0.9
Lysine (%)	1.39	1.26	1.11
Calcium (%)	0.9	0.88	0.83
Available phosphorous (%)	0.44	0.41	0.38
Crude fiber (%)	2.73	2.64	2.58

* The protein concentrate used is animal, produced by a Dutch company (Brocon). It contains 40% crude protein, 2017 kilocalories/ kg. The protein concentrate contains approximately 5% crude fat, 2.20% crude fiber, 5.00% calcium, 4.68% phosphorus, 3.85% lysine, 1.12% methionine, 4.12% methionine + cysteine, 0.42% tryptophan, and 1.70% threonine. It also includes a balanced mixture of essential vitamins and minerals to meet the nutritional requirements of the birds. ** Chemical composition according to the recommendations of the NRC (1994).

STUDIED TRAITS

Carcass traits: After slaughter and chilling, carcasses were cut into primary parts (breast, thigh, and drumstick) and secondary parts (back, neck, and wings). Each part was weighed separately, and its relative weight (%) was calculated as a proportion of the total carcass weight, according to the method described by [USDA \(1998\)](#).

Relative weight of immune organs: The bursa of Fabricius was carefully removed from each bird after dissecting the surrounding connective tissue. The organ was weighed using a sensitive balance, and its relative weight was calculated according to [Lucio and Hitchner \(1979\)](#). The bursa index was calculated as described by [Lucio and Hitchner \(1979\)](#). The spleen was excised and weighed, and its relative weight was calculated following the method of [USDA \(1998\)](#).

Liver enzymes AST, ALT, and ALP: Serum activities of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were determined using commercial diagnostic kits (Biolabo, France) according to the method of [Reitman and Frankel \(1957\)](#). Absorbance was measured using a spectrophotometer at a wavelength of 546 nm. Alkaline phosphatase (ALP) activity was measured using a commercial kit (bioMérieux, France) following the method of [Kind and King \(1954\)](#).

To ensure the reliability of biochemical measurements, careful attention was given to blood sample collection, handling, and serum preparation. Pre-analytical factors were controlled throughout the experiment in accordance with recommendations reported by [Al-Salhi \(2025\)](#) and [Al-Salhi et al. \(2026a\)](#).

STATISTICAL ANALYSIS

Data were analysed using a standard statistical software package ([Alloush and Salman, 2016](#)). Significant differences among treatment means were determined using Duncan's multiple range test ([Duncan, 1955](#)).

RESULTS AND DISCUSSION

[Table 2](#) shows the effect of supplementing drinking water with aqueous and alcoholic extracts of Iraqi jasmine (*Lonicera japonica* L.) leaves on the relative weights of the main and secondary carcass parts of broiler chickens. For the drumstick, a significant difference ($P \leq 0.05$) was observed among treatments. The first treatment (control) recorded the highest relative weight compared to the second, third, fourth, fifth, and seventh treatments, while it did not differ significantly from the sixth treatment.

Regarding the secondary parts (wings and back), no significant differences were found among treatments in

the relative weight of the wings. However, for the back, the fourth treatment recorded the highest relative weight (17.43%), showing a significant difference ($P \leq 0.05$) compared to the fifth treatment (13.16%), while no significant differences were observed with the remaining treatments. For the neck, the first (control) and fifth treatments recorded the highest relative weights, with significant differences ($P \leq 0.05$) compared to the second, fourth, and sixth treatments, whereas no significant differences were observed among the third, sixth, and seventh treatments.

The observed increases in the weights of certain carcass parts may be attributed to the role of jasmine leaf extracts as natural growth promoters and alternatives to antibiotics, which can enhance growth performance (Rehman *et al.*, 2019; Ali *et al.*, 2019). These improvements may also be associated with better nutrient utilization and the biological activity of phytochemicals present in plant-based additives. Such materials are known to contain bioactive compounds with antimicrobial and growth-promoting properties, contributing to improved feed efficiency and overall production performance in poultry (Naser *et al.*, 2025).

Furthermore, these findings align with the increasing emphasis on sustainable and environmentally friendly production systems that enhance resource utilization and support responsible agricultural practices (Alabresm *et al.*, 2026). In addition, recent advancements in poultry production highlight the integration of biotechnological and innovative approaches, such as bacterial starters and bio-fermentation systems for poultry waste management, which improve environmental sustainability and animal health (Al-Salhi *et al.*, 2025b, 2026b). These technologies may complement the use of natural feed additives in

achieving more sustainable poultry production systems.

The results of the statistical analysis presented in Table 3 show the effect of supplementing drinking water with aqueous and alcoholic extracts of Iraqi jasmine (*Lonicera japonica* L.) leaves on the relative weights of lymphoid organs (% of body weight) in broiler chickens at 35 days of age. The results indicate that there were no significant differences among all experimental treatments. The absence of significant differences in the relative weights of the bursa of Fabricius and spleen suggests that supplementation with jasmine leaf extracts did not adversely affect the normal development of immune organs. The maintenance of normal lymphoid organ development is generally considered an indicator of adequate immune status and physiological stability in broiler chickens. Similar findings have been reported in studies evaluating natural immunomodulatory supplements, where improvements in immune function occurred without significant changes in lymphoid organ weights (Al-Salhi, 2026a).

The results presented in Table 4 show the effect of supplementing drinking water with aqueous and alcoholic extracts of Iraqi jasmine (*Lonicera japonica* L.) on liver enzyme concentrations in the serum of broiler chickens at 35 days of age. The first treatment (control) recorded the highest concentration of alanine aminotransferase (ALT), with a significant difference ($P \leq 0.05$) compared to all supplemented treatments, where the ALT value reached 13.97 U/L. A similar trend was observed for aspartate aminotransferase (AST), as the control group showed the highest enzyme concentration, differing significantly ($P \leq 0.05$) from the fourth, sixth, and seventh treatments, which recorded the lowest AST values. However, no significant differences were observed between the control group and the second, third, and fifth treatments.

Table 2: Effect of supplementing drinking water with aqueous and alcoholic extracts of *Lonicera japonica* Leaves on the relative weights (%) of main and secondary carcass parts in broiler chickens (Mean $\pm$ SE).

Treatments	Breast (%)	Thigh (%)	Drummer stick (%)	Wings (%)	Back (%)	Neck (%)
First treatment	36.53 $\pm$ 1.53	15.10 $\pm$ 0.90	14.66 $\pm$ 0.40 ^a	9.30 $\pm$ 0.36	15.36 $\pm$ 1.41 ^{ab}	6.73 $\pm$ 0.17 ^a
Second treatment	40.63 $\pm$ 1.42	14.46 $\pm$ 0.49	12.86 $\pm$ 0.28 ^b	9.40 $\pm$ 0.20	16.53 $\pm$ 0.76 ^{ab}	5.56 $\pm$ 0.14 ^c
Third treatment	39.26 $\pm$ 0.76	15.20 $\pm$ 0.32	12.90 $\pm$ 0.34 ^b	9.03 $\pm$ 0.14	15.96 $\pm$ 0.86 ^{ab}	6.60 $\pm$ 0.23 ^{ab}
Forth treatment	38.83 $\pm$ 0.75	15.30 $\pm$ 0.43	12.60 $\pm$ 0.17 ^b	9.40 $\pm$ 0.35	17.43 $\pm$ 0.40 ^a	5.73 $\pm$ 0.26 ^{bc}
Fifth treatment	42.26 $\pm$ 2.20	15.36 $\pm$ 0.82	12.53 $\pm$ 0.51 ^b	9.63 $\pm$ 0.52	13.16 $\pm$ 0.61 ^b	6.73 $\pm$ 0.31 ^a
Sixth treatment	41.40 $\pm$ 0.46	15.76 $\pm$ 0.97	13.56 $\pm$ 0.12 ^{ab}	9.06 $\pm$ 0.39	14.53 $\pm$ 0.67 ^{ab}	5.66 $\pm$ 0.52 ^{bc}
Seventh treatment	39.10 $\pm$ 3.45	15.93 $\pm$ 0.53	12.43 $\pm$ 0.76 ^b	8.66 $\pm$ 0.55	14.83 $\pm$ 2.18 ^{ab}	6.30 $\pm$ 0.20 ^{abc}
Significant level	N.S	N.S	*	N.S	*	*

The first treatment (control) received drinking water without any supplementation. The second, third, and fourth treatments received aqueous extract of jasmine leaves at a dose of 10 ml/L of drinking water with concentrations of 15%, 30%, and 45%, respectively. The fifth, sixth, and seventh treatments received alcoholic extract of jasmine leaves at the same dose (10 ml/L) with concentrations of 15%, 30%, and 45%, respectively. *: indicates a significant difference at the level of ($P \leq 0.05$). N.S: indicates no significant differences among treatments.

Table 3: Effect of supplementing drinking water with aqueous and alcoholic extracts of *Lonicera japonica* leaves on the relative weights of lymphoid organs (% of body weight) in broiler chickens at 35 days of age (Mean $\pm$ SE).

Treatments	Bursa of Fabricius weight (%)	Bursa index	Spleen weight (%)
First	0.073 $\pm$ 0.004	1.000 $\pm$ 0.001	0.129 $\pm$ 0.008
Second	0.090 $\pm$ 0.016	1.216 $\pm$ 0.167	0.135 $\pm$ 0.009
Third	0.112 $\pm$ 0.031	1.539 $\pm$ 0.402	0.137 $\pm$ 0.005
Forth	0.113 $\pm$ 0.032	1.592 $\pm$ 0.504	0.148 $\pm$ 0.005
Fifth	0.076 $\pm$ 0.003	1.043 $\pm$ 0.089	0.146 $\pm$ 0.011
Sixth	0.129 $\pm$ 0.028	1.731 $\pm$ 0.310	0.136 $\pm$ 0.005
Seventh	0.100 $\pm$ 0.016	1.373 $\pm$ 0.227	0.160 $\pm$ 0.016
Significant level	N.S	N.S	N.S

The first treatment (control) received drinking water without any supplementation. The second, third, and fourth treatments received aqueous extract of jasmine leaves at a dose of 10 ml/L of drinking water with concentrations of 15%, 30%, and 45%, respectively. The fifth, sixth, and seventh treatments received alcoholic extract of jasmine leaves at the same dose (10 ml/L) with concentrations of 15%, 30%, and 45%, respectively. N.S: indicates no significant differences among treatments.

Table 4: Effect of supplementing drinking water with aqueous and alcoholic extracts of *Lonicera japonica* leaves on liver enzyme concentrations (ALT, AST, and ALP) in the serum of broiler chickens at 35 days of age (Mean $\pm$ SE).

Treatments	ALT (unit/liter)	AST (unit/liter)	ALP (unit/liter)
First	13.97 $\pm$ 0.69 ^a	128.44 $\pm$ 0.90 ^a	1269.10 $\pm$ 33.56
Second	10.91 $\pm$ 0.16 ^b	114.14 $\pm$ 5.19 ^{abc}	1400.32 $\pm$ 173.09
Third	10.71 $\pm$ 0.04 ^b	110.46 $\pm$ 2.05 ^{abc}	1334.31 $\pm$ 66.39
Forth	10.45 $\pm$ 0.79 ^b	107.08 $\pm$ 7.83 ^{bc}	1319.51 $\pm$ 79.61
Fifth	11.37 $\pm$ 0.64 ^b	122.64 $\pm$ 4.03 ^{ab}	1401.03 $\pm$ 26.26
Sixth	11.21 $\pm$ 0.17 ^b	102.98 $\pm$ 8.31 ^c	1436.30 $\pm$ 67.56
Seventh	10.33 $\pm$ 0.50 ^b	102.08 $\pm$ 6.96 ^c	1316.00 $\pm$ 21.17
Significant level	*	*	N.S

The first treatment (control) received drinking water without any supplementation. The second, third, and fourth treatments received aqueous extract of jasmine leaves at a dose of 10 ml/L of drinking water with concentrations of 15%, 30%, and 45%, respectively. The fifth, sixth, and seventh treatments received alcoholic extract of jasmine leaves at the same dose (10 ml/L) with concentrations of 15%, 30%, and 45%, respectively. *: indicates a significant difference at the level of (P $\leq$ 0.05). N.S: indicates no significant differences among treatments.

In contrast, alkaline phosphatase (ALP) levels showed no significant differences among all treatments, including the control group. The overall stability observed in liver enzyme activities suggests that supplementation with jasmine leaf extracts did not adversely affect liver function and may contribute to maintaining hepatic health and metabolic

balance in broiler chickens.

These findings are consistent with previous studies (Abbas *et al.*, 2018; Kuzmina *et al.*, 2021), which reported that natural plant-based supplements can improve physiological responses without causing hepatic stress. The reduction in ALT and AST activities in the treated groups may indicate improved liver function and reduced hepatocellular damage, which is often associated with oxidative stress and metabolic disturbances. Elevated levels of these enzymes are typically linked to increased tissue damage and oxidative stress (Kuhn, 1998; Ali *et al.*, 2021; Merzah and Ali, 2022).

The results also align with findings by Al-Salhi and Al-Shatty (2023), who demonstrated that biologically active compounds can enhance physiological and metabolic stability in poultry. Therefore, it can be suggested that jasmine leaf extracts possess hepatoprotective properties, likely due to their antioxidant and antimicrobial activities, making them a beneficial natural additive in poultry production systems.

CONCLUSION

Based on the results of the present study, it can be concluded that supplementation of drinking water with extracts of Iraqi jasmine (*Lonicera japonica* L.) positively influenced carcass traits and physiological parameters in broiler chickens. The addition of jasmine leaf extracts contributed to improvements in the relative weights of body parts as well as maintaining normal physiological functions, including liver enzyme activity and immune organ development. Among the tested treatments, the alcoholic extract at concentrations of 30% and 45%, along with the aqueous extract at 45%, demonstrated the most favourable effects compared to other experimental groups. These findings suggest that jasmine leaf extracts, particularly at higher concentrations, can be effectively used as natural feed additives to enhance growth performance and physiological stability in broiler chickens.

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NOVELTY STATEMENT

The novelty of this study lies in the evaluation of aqueous

and alcoholic extracts of Iraqi jasmine leaves (*Lonicera japonica* L.) as natural additives administered through drinking water in broiler chickens. The study provides comparative evidence on the effects of different extract types and concentrations on carcass characteristics, lymphoid organ development, and selected liver enzyme activities. The findings contribute to the understanding of the potential use of *L. japonica* leaf extracts as natural phytogenic additives in broiler production.

AUTHOR'S CONTRIBUTION

Najeh Jabir Al-Shemery, Nihad Abdul-Lateef Ali, Bushra S. R. Zangana, and Sabah M. Al-Shatty contributed to the original drafting of the manuscript.

Ahmed F. Kadhim, Nasrallah Radhi Misjel, and Ali Shamkhi Jabbar contributed to the methodology and statistical analysis.

Elaf H. Al-Jumaili was responsible for correspondence with the journal.

Mohammed S. Eukaal contributed to manuscript revision and formatting.

All authors reviewed and approved the final version of the manuscript.

GENERATIVE AI AND AI ASSISTED TECHNOLOGY STATEMENT

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

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