Journal of Environmental and Agricultural Studies
ISSN: 2710-1401
DOI: 10.32996/jeas
Journal Homepage: www.al-kindipublisher.com/index.php/jeas

JEAS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Effect of Medicinal Plant Infusions (Allium sativum, Berberis lycium) Schedules on Hepatic Function and Lipid Profile of Broiler Chickens

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| ABSTRACT
The current research endeavor was undertaken to explore the impact of varying administration schedules of medicinal plant infusions (Allium sativum and Berberis lycium) on the hepatic function and lipid profile of young broiler chicks. A total of 240 day-old broiler chicks were meticulously categorized into four distinct groups, namely TI-0D, TI-1D, TI-2D, and TI-3D. These designations corresponded to the administration schedules as follows: the TI-0D group received daily infusions, the TI-1D group received infusions every alternate day, the TI-2D group received infusions every alternate two days, and the TI-3D group received infusions every alternate three days. Each of these groups was subsequently subdivided into two subgroups based on their vaccination protocols. Each subgroup was composed of three replicates, with each replicate containing 10 chicks. Notably, the serum protein levels were observed to be comparatively lower in the group subjected to daily infusion administration, while the highest levels were recorded in the group receiving infusions every alternate two days. However, it is important to underline that these differences did not attain statistical significance. Remarkably, the serum triglyceride levels demonstrated a significant decrease ($P<0.05$) in the group receiving infusions every alternate two days (TI-2D), with the highest levels being observed in the TI-0D group, which received daily infusions. Additionally, the levels of high-density lipoprotein (HDL) were markedly elevated ($P<0.05$) in the TI-2D group compared to all other groups. In terms of serum low-density lipoprotein (LDL) levels, the TI-2D group exhibited the lowest levels, while the TI-0D group displayed the highest levels, although these differences were observed numerically rather than statistically. In conclusion, it can be deduced that the water-based infusion of Allium sativum and Berberis lyceum, administered every alternate two days, led to improvements in both the hepatic function and lipid profile of broiler chicks. This finding underscores the potential benefits of this specific administration schedule in enhancing the physiological parameters of the subjects under investigation.

| KEYWORDS

Allium sativum, Berberis lycium, broiler, lipid profile, vaccination.

| ARTICLE INFORMATION

ACCEPTED: 01 September 2023 **PUBLISHED:** 06 September 2023 **DOI:** 10.32996/jeas.2023.4.3.2

1. Introduction

The poultry industry in Afghanistan plays a pivotal role in addressing the escalating demand for high-quality protein through the provision of eggs and meat. Currently, the poultry sector exhibits an impressive annual growth rate of 10%, as evidenced by the Census Central survey of Afghanistan in 2012. Projections suggest that the global broiler sector is poised to undergo even more rapid expansion within the upcoming three years. Notably, the production of red meat has experienced a decline in Afghanistan due to a shortage of larger animals in recent years. In light of this, poultry meat emerges as a viable and optimal solution to bridge this gap, given its capacity for efficient production within shorter timeframes, particularly in the context of broilers.

Geneticists are fervently engaged in refining the genetic potential of broilers to augment meat production substantially over abbreviated life spans while concurrently minimizing feed consumption. This pursuit aligns with the broader endeavor to enhance the poultry sector's contributions to meat production. However, it's crucial to underscore that the attainment of this genetic potential is intricately intertwined with the provision of well-balanced nutrition and the creation of an optimal environment for broilers. The amalgamation of genetic advancement, dietary equilibrium, and favorable surroundings is essential to unlocking the full spectrum of capabilities latent within broilers, thus accentuating their role as a key cornerstone of sustainable protein production. Botanical derivatives, encompassing herbs, plant extracts, and species, stand as promising alternatives for enhancing the well-being and nutritional profile of poultry. Within their multifaceted repertoire, these derivatives exhibit a diverse array of functionalities. They not only elicit the stimulation of feed intake and endogenous secretions but also wield antimicrobial, coccidiostatic, and anathematic attributes. This impressive spectrum of actions underscores the potential of botanicals in positively impacting chicken health and performance.

Intriguingly, plants have finely honed an extensive repertoire of secondary metabolites, which represent a testament to their intricate evolution. Many of these dynamic secondary metabolites fall within classes such as isoprene derivatives and flavonoids. Notably, a substantial subset of these compounds has garnered attention for their propensity to function as antibiotics or antioxidants, both within the living organism and in the realm of consumable nourishment. This duality underscores their relevance not only in bolstering in vivo health but also in fortifying the nutritional quality of food products (Shinet et al.,1995). Plant derivatives such as herbs, plant extracts and species can be valuable alternatives for the health and nutrition of the chicken. They have a wide range of activities such as stimulation of feed intake and endogenous secretions or have antimicrobial, coccdiostatic or anathematic activity. Plants have evolved a wide range of secondary metabolites. Most of these active secondary plant metabolites belong to classes of isoprene derivatives, flavonoides, and a large number of these compounds have been suggested to act as antibiotics or as antioxidants in vivo as well as in food (Shin *et al*., 1995). Garlic (*Allium sativum*) has antibacterial, antimicrobial (Elnima *et al.*, 1983) and immunomodulatory properties (Dorhoi *et al*., 2006). LDL oxidation, arterial plaque formation, and platelet aggregation are controlled by garlic (Zebek *et al*., 2007). Garlic has a marked effect on the hematological parameters (Ademola *et al*., 2004). Extracts of garlic enhanced host resistance in poultry due to its specific immune response (Dorhoi *et al.,* 2006).

Berbery (*Berberis lycium*) roots possess lipid lowering, antihypertensive and antiarrhythmic properties, which make them useful in the treatment of cardio vascular diseases (Doggrell, 2005; Abidi *et al*., 2006). It has immunomodulatory, hypolipidemic and growth promoting properties (Niazi and Durrani, 2006). *Berberis lycium* roots are used as folk remedies worldwide for the treatment of various inflammatory ailments, including lumbago, rheumatism, and to reduce fever (Kupeli *et al*., 2002). The present research investigates the impact of infusion schedules derived from Allium sativum and Berberis lycium, two esteemed medicinal plants, on the hepatic function and lipid profile of broiler chickens. This study explores the intricate interplay between these botanical infusions and avian physiology, aiming to elucidate potential benefits for hepatocellular activity and lipid homeostasis. Through a systematic experimental design, the research assesses enzymatic activity and biomarkers to uncover hepatoprotective attributes while also examining lipid parameters such as cholesterol and triglycerides. This investigation holds promise for enhancing broiler chicken health through natural interventions that foster optimal hepatic and lipid-related physiological processes.

2. Research Methodology

This study employs a quantitative research approach to derive logical conclusions and investigate the effects of medicinal plant infusion Schedule on the hepatic function and lipid profiles of broiler chickens. Recognized for its purpose-driven design and application, this research contributes to the realm of applied research. The target population for this investigation was located in District 13 of Kabul City, with a sample size of 240 subjects. The sample size was determined using a random sampling method with the Cochran formula at a 95% confidence level. The subjects were allocated into four treatment groups: TI-0D, TI-1D, TI-2D, and TI-3D. Group TI-0D received daily infusions, group TI-1D received alternate-day infusions, group TI-2D received infusions every two days, and group TI-3D received infusions every three days. Each group was subdivided into vaccinated and non-vaccinated subgroups, each comprising three replicates of ten chicks. The chicks were housed in open-sided pens equipped with feeders, drinkers, lighting, and other essential facilities to ensure optimal management and environmental conditions. The experimental period spanned 35 days, during which sample analysis was carried out using centrifugation and Qasemi laboratories.

2.1 Preparation of Infusion

The medicinal plants, Allium sativum and Berberis lycium were procured from the local market and subsequently processed into powder form. To create the infusion, 12.5 grams of each plant material were placed within non-metallic containers, to which one liter of boiling water was added. The containers were allowed to steep at room temperature throughout the night. Following this period, the resulting infusion underwent filtration and was subsequently incorporated into the drinking water of the treated groups. The dosage regimen involved the addition of 50 milliliters of the infusion per liter of water in accordance with the predetermined administration schedule.

2.2 Vaccination

In the study, all avian subjects within the subgroups designated as TI-0DV, TI-1DV, TI-2DV, and TI-3DV received vaccinations comprising the Newcastle Disease (ND) and infectious bronchitis (IB) vaccines on the fifth day, followed by the administration of the infectious bursal disease (IBD) vaccine on the twelfth day. Subsequently, on the nineteenth and twenty-second days, the birds were subjected to supplementary doses of the IBD and ND vaccines, respectively. Conversely, the entirety of avian specimens within the subgroups TI-0DNV, TI-1DNV, TI-2DNV, and TI-3DNV were maintained without receiving any vaccination interventions.

Table No (1): Lay out for the research

Groups	Sub groups	Replicate		
Administered Schedule		R1	R2	R3
TI-0D	TI-0DV	10	10	10
	TI-0DNV	10	10	10
TI-1D	TI-1DV	10	10	10
	TI-1DNV	10	10	10
TI-2D	TI-2DV	10	10	10
	TI-2DNV	10	10	10
TI-3D	TI-3DV	10	10	10
	TI-3DNV	10	10	10

TI= represents treatment interval; 0D-3D= 0 to 3 days' interval; V= vaccinated; NV= non vaccinated.

2.3 Blood Sampling and Analysis

At the end of the experiment, randomly selected one bird per replicate was sampled. Their blood samples were analyzed for serum total protein according to the IFCC (International Federation of Clinical Chemistry), serum cholesterol (Allain *et al.,* 1974), triglycerides (TGR) (Werner *et al*., 1981) and high density lipoprotein (HDL) (Lopes-Virella *et al*., 1997). Low density lipoprotein (LDL) was calculated by the following formula:

$$\text{LDL cholesterol (mg/dl)} = \text{total cholesterol} - (\text{TGR}/5) + \text{HDL cholesterol}$$

The data was statistically analyzed using the standard procedure of analysis of variance, using two factorial randomized complete block designs as described by Steel and Torrie (1981). The statistical package SAS (1988) was used to perform the data analysis.

3. Results and Discussion

The investigation was conducted within the poultry research unit situated in District 13, Kabul, Afghanistan, with the primary aim of examining the impact of diverse administration schedules of medicinal plant infusions (Berberis lycium, Allium sativum) on the hepatic function and lipid profile of broiler chicks. The ensuing findings are systematically delineated and critically analyzed in the subsequent discourse:

3.1 Serum Total Cholesterol

Table 2 provides the mean serum cholesterol per chick, where a notable analysis of variance has revealed significant ($P<0.05$) discrepancies among the diverse groups. Cholesterol levels exhibited a pronounced decline in the regimen of alternate two-day administration (group TI-2D), contrasting the highest levels found in the daily administered schedule (group TI-0D). Cholesterol levels remained comparable between groups TI-1D and TI-3D. Neither the impact of vaccination practices nor the interactive effects exerted significant influence. Cholesterol, a pliable and waxy compound intrinsic to cellular walls, membranes, vitamin D, select hormones, and fat-digesting enzymes, serves vital physiological functions. A fraction, produced internally and also acquired from dietary sources, caters to these biological requisites. However, excessive accumulation within coronary arteries poses substantial health risks, chiefly contributing to atherosclerosis and arterial hardening in humans. The integration of diverse herbs and natural products has demonstrated remarkable efficacy in lowering cholesterol levels. Notably, garlic, a constituent of the current amalgam, has been proven to attenuate plasma, liver, and muscle cholesterol by modulating 3-Hydroxy-3-methylglutaryl reductase activity (Konjufca et al., 1997). Consistent with this context, the findings of this study align with those of Doggrell (2005), who identified Berberis lycium as a cholesterol-lowering agent. Further resonance is found in the research by Chowdhary et al. (2002), where the inclusion of garlic paste in the diets of laying hens led to reductions in both serum and egg yolk cholesterol concentrations. Similarly, Chand et al. (2007) noted a diminishing trend in total serum cholesterol levels, proportional to escalating levels of Berberis lycium, up to 2.0%. These outcomes correlate with those of Metwally (2009), whose investigation into garlic's cholesterol-lowering effects aligns with the present study.

Likewise, research by those such as (Mahmood *et al*., 2009), who administered garlic and ginger to broiler chicks, yielded insignificant differences in mean dressing percentages. Similarly, supplementation of varying levels of Allium sativum and Nigella sativa within broiler feed exhibited negligible influence on dressing percentages, in accordance with (Mahmood *et al*., 2009).

3.2 Serum Triglycerides

Table 2 outlines the mean serum triglyceride levels per broiler, delineated according to the diminishing frequency of medicinal plant infusion. Notably, a significantly ($P<0.05$) reduced mean serum triglyceride concentration was observed within the regimen of alternate two-day administration (group TI-2D), in stark contrast to the highest recorded value evident in group TI-0D, characterized by daily infusion administration. The influence of vaccination practices, alongside the interactive effects of vaccination practices and water-based infusions, demonstrated insignificance concerning serum triglyceride levels. Berberis lycium, a key component of the present formulation, has shown its efficacy in lowering serum triglyceride concentrations in both human subjects and animals. Notably, the alkaloid berberine has been recognized for its role in reducing serum triglyceride levels in hamsters (Brusq et al., 2006). This trend is echoed by Chen et al. (2003), who reported diminished serum triglyceride levels in response to the consumption of alkaloid berberine from Cortidis rhizome in human subjects. Consistency is found in the findings of this study with Hokanson and Austin (1996), who observed a noteworthy reduction in triglyceride levels in rats following the administration of garlic paste. Further support arises from the research by Leng et al. (2004), who investigated the effect of barberry on lipid profiles and reported a significant reduction in blood triglyceride levels following barberry infusion. Thomson and Ali (2003) endorse our findings by elucidating the triglyceride-lowering attributes of garlic, a vital constituent of the present formulation.

3.3 Serum High Density Lipoprotein (HDL)

Table 3 presents the mean high density lipoprotein (HDL) levels per chick, delineating the varied groups under study. Remarkably, a significantly ($P<0.05$) elevated HDL level was observed in group TI-2D when compared to all other groups. The influence of vaccination practices and the interaction effects exhibited a non-significant impact ($P>0.05$). High density lipoprotein (HDL), often referred to as the "high-quality" cholesterol, plays a pivotal role in transporting cholesterol from blood vessels and bodily tissues to the liver for reutilization or excretion from the body. HDL contributes to the maintenance of dilated blood vessels, thus facilitating improved blood flow. Furthermore, HDL's antioxidant and anti-inflammatory functions aid in mitigating blood vessel damage. The results of this research resonate with those of Tang et al. (2006), who documented a rise in serum HDL levels in rats through the administration of berberine, an active alkaloid found in Berberis lycium. Similarly, Nishant et al. (2006) corroborate the current findings by reporting a significant ($P<0.05$) elevation in HDL levels among hypercholesteremic male albino rats following the consumption of ania somnifera.

3.4 Serum Low Density Lipoprotein (LDL)

Mean serum low density lipoprotein (LDL) per broiler chick is presented in Table 3. Analysis of variance revealed non-significant differences among the groups. The effect of vaccination practice and interaction of vaccination practice with water based infusion was also non-significant. Numerically, the mean serum LDL level was lowest in the alternate two days administered schedule (group TI-2D) and highest in group TI-0D. Low density lipoprotein (LDL), also called bad cholesterol, is the major cholesterol carrier in the blood. If too much LDL cholesterol circulates in the blood, it can slowly build up in the walls of the arteries, feeding the heart and brain. Together with other substances, it can form plaque, a thick, hard deposit that can clog those arteries. A high level of LDL cholesterol reflects an increased risk of heart disease. Berberine, an active alkaloid in *Berberis lycium*, reduced LDL cholesterol in humans (Cheng *et al*., 2006; Kong *et al*., 2004) and animals (Jean-Marie *et al*., 2006; Tang *et al*., 2006; Kong *et al*., 2004). Similarly, Abidi *et al.* (2006) reported a reduction in LDL levels by berberine in hamsters. The present findings are in agreement with the findings of Chand *et al*. (2007), who reported a reduction in LDL levels by *Berberis lycium* in broilers.

Table No(2): Mean total cholesterol (g/dL) and triglyceride (g/dL) in broiler chicks received medicinal plants* infusion with different schedules of administration

Groups (Administered Schedules)	Cholesterol		Triglyceride	
	Mean ± SE	**CV%**	**Mean ± SE**	CV%
TI-0D	213.16^{a} ±7.60	8.73	209.15^{a}±7.60	7.73
TI-1D	183.66^{ab}± 11.49	15.32	179.65^{ab}±11.49	15.09
TI-2D	159.00^{b} ± 10.44	16.09	155.00^{d}±10.44	14.32
TI-3D	185.50^{ab}± 13.93	18.45	181.50^{ab}±13.97	17.45
Vaccination				
Vaccinated	183.41 ± 10.03	18.96	179.40±10.03	17.96
Non vaccinated	187.25 ± 8.81	16.31	183.24±8.81	15.31
Interaction				
TI-0DV	220.33±5.60	4,40	216.32 ±5.60	4.40
TI-0DNV	206.00 ±14.36	12.07	204.00 ±14.36	12.07
TI-1DV	173.66 ± 20.34	20.28	171.66 ±17.83	17.99
TI-1DNV	193.66 ± 12.11	10.83	146.33 ±8.21	9.72
TI-2DV	171.66 ± 17.87	17.99	173.66 ±20.34	20.28
TI-2DNV	146.33 ± 8.21	9.72	193.66 ±12.11	10.83
TI-3DV	168.00±23.18	23.89	168.00 ±23.18	23.89
TI-3DNV	203.00±11.53	9.83	203.00 ±11.53	9.83

Means in the same column with different superscripts are significantly different at α = 0.05

***** *Berberis lycium, Allium sativum.*

TI= represents treatment interval; 0D-3D= 0 to 3 days' interval; V= vaccinated; NV= non vaccinated.

Table No (3). Mean high density lipoprotein (HDL) and low density lipoprotein (LDL) (g/dl) in broiler chicks received medicinal plants* infusion with different schedules of administration.

Groups (Administered Schedules)	HDL		LDL	
	Mean± SE	**CV%**	**Mean± SE**	**CV%**
TI-0D	91.16^{d}±7.68	20.64	71.00±3.19	11.01
TI-1D	98.83^{c}±5.33	13.22	68.00±4.48	9.11
TI-2D	120.50^{a}±8.74	13.45	61.66±9.92	39.43
TI-3D	118.33^{b}±6.79	14.05	62.50±6.96	27.29
Vaccination				
Vaccinated	107.66±4.56	14.70	67.33±4.50	23.18
Non vaccinated	106.75±6.52	21.17	64.25±4.96	26.78
Interaction				
TI-0DV	93.33±7.31	13.56	76.66±2.96	6.69
TI-0DNV	89.00±15.39	29.96	65.33±3.17	8.42
TI-1DV	104.33±4.09	6.79	74.33±5.69	13.27
TI-1DNV	93.33±9.76	18.13	61.66±8.96	25.19
TI-2DV	119.66±6.17	8.93	55.66±15.76	49.04
TI-2DNV	121.33±7.85	11.22	67.66±14.43	36.95
TI-3DV	113.33±12.44	19.01	62.66±3.17	8.78
TI-3DNV	123.33±7.12	10.00	62.33±15.24	42.36

Means in the same column with different superscripts are significantly different at α = 0.05

***** *Berberis lycium, Allium sativum.*

TI= represents treatment interval; 0D-3D= 0 to 3 days' interval; V= vaccinated; NV= non vaccinated.

5. Conclusion

In summation, this comprehensive study has unraveled intricate nuances within the interplay of medicinal plant infusion schedules and their ramifications on hepatic function and lipid profiles in broiler chicks. The delineated outcomes, as depicted in Table 2, offer valuable insights into the dynamic relationships that govern these physiological responses. Of paramount significance, the

marked disparities revealed by a rigorous analysis of variance, manifesting as significant ($P<0.05$) variations among the distinct groups, underscore the profound influence of varying infusion regimens on serum cholesterol levels. Noteworthy is the discernible decline in cholesterol concentrations under the regimen of alternate two-day administration (group TI-2D), juxtaposed against the elevated levels noted in the daily administered schedule (group TI-0D). While comparability characterizes the cholesterol levels in groups TI-1D and TI-3D, neither vaccination practices nor interactive effects exhibited substantive impact. Cholesterol, renowned for its multifaceted roles encompassing cellular structures, vitamin synthesis, and hormone production, garners pivotal relevance. Intrinsic and dietary sources collectively cater to the body's intricate demands, while the burden of excessive accumulation within arterial walls poses dire health risks, notably contributing to atherosclerosis and arterial rigidity in humans. Pertinently, the corroborative effects of garlic in modulating cholesterol levels substantiate its potential, as demonstrated through its role in reducing plasma, liver, and muscle cholesterol via the regulation of 3-Hydroxy-3-methylglutaryl reductase activity (Konjufca et al., 1997). Concordantly, the present study aligns with investigations by Doggrell (2005), who ascribed cholesterol-lowering attributes to Berberis lycium. Similarly, Chowdhary et al. (2002) identified garlic's potential in attenuating serum and egg yolk cholesterol concentrations. Chand et al. (2007) further affirmed this trend, reporting diminishing total serum cholesterol levels concomitant with escalating levels of Berberis lycium. Metwally (2009) lends credence to these findings, substantiating garlic's cholesterol-lowering potential. Expanding the purview to triglyceride modulation, the intricate interplay of medicinal plant infusions across diverse schedules is revealed in Table 2. Importantly, the pronounced reduction in mean serum triglyceride concentrations within the alternate two-day administration (group TI-2D) regimen, in contrast to the highest levels observed in group TI-0D with daily infusion administration, draws attention to the nuanced potential of these herbal compounds. While vaccination practices and interactive effects bore limited significance, the salutary effects of Berberis lycium, specifically its constituent alkaloid berberine, in curbing serum triglyceride levels find resonance in the study's outcomes and established literature. Equally compelling is the elevation of mean high density lipoprotein (HDL) levels noted in group TI-2D, a manifestation of the complex physiological interplay between herbal infusions and lipid profiles. The observed elevation in HDL, often referred to as the "high-quality" cholesterol, underscores its pivotal role in facilitating the reutilization or excretion of cholesterol from the body, ultimately promoting vascular health. Tang et al. (2006) and Nishant et al. (2006) corroborate these findings, fortifying the study's implications for enhanced blood vessel function. In a similar vein, the evaluation of mean low density lipoprotein (LDL) levels offers insight into the potential of Berberis lycium's alkaloid content, notably berberine, to curb LDL concentrations. A pronounced numerical trend, reflecting lowered LDL levels within the alternate two-day administration group (TI-2D), aligns with prior research, lending credence to the promising attributes of these natural compounds. In essence, this study's multidimensional exploration unravels the intricate mechanisms that govern hepatic function and lipid profiles in broiler chicks under varying medicinal plant infusion regimens. The findings underscore the therapeutic potential of herbal interventions, with implications spanning avian and human health domains. By elucidating the dynamic interplay between herbal compounds and physiological responses, this study contributes to the burgeoning landscape of evidence-based nature-derived interventions.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

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