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Effect of Supplementation of Dried Chicory (*Cichorium Intybus* L.) Herb Leaves in Diets of Growing Kids on their Growth Performance, Blood Parameters and Hematological Profile

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Abstract | Twenty four growing kids were chosen after weaning at three months of age and used in a comparative feeding trial to estimate the effect of supplementation of dried chicory herb leaves (DCHL) in their diets on nutrient digestibility, growth performance, some blood parameters and hematological profile. Animals were chosen with an average body weight 15.40±1.99kg and divided randomly into three similar groups (8 kids/each). The 1st group (G0) was fed the control diet formulated from concentrate feed mixture and berseem hay with rate of 60 and 40%, respectively. Kids in the 2nd (G1) and 3rd (G2) groups were fed the control ration supplemented with 1% or 2%-DCHL as a replacement of berseem hay in control ration. Results revealed that digestion coefficients, feeding value, final body weight and weight gain were significantly (P<0.05) higher with diets containing up to 2%-DCHL than control one. Feed intake were higher (P<0.05) for G1 compared with those of the other dietary treatments. Diets involved up to 2%-DCHL had achieved the best (P<0.05) feed conversion compared with control one. In blood plasma, concentrations of total protein, albumin and globulin as well as activity of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were significantly (P<0.05) increased while, glucose, total cholesterol, uric acid and creatinine were significantly decreased (P<0.05) in G1 as compared to unsupplemented group. Kids in G1 group recorded the highest (P<0.05) concentrations of hemoglobin, mean corpuscular volume and mean corpuscular hemoglobin, while, G0 had the lowest value. Meanwhile, red blood cells count, hematocrit and lymphocytes% were nearly similar in all groups. Mean corpuscular hemoglobin concentration, percentages of differential white blood cells count and eosinophils% were significantly higher in G1 and G2 comparing with the control diet. In conclusion, kids fed diet supplemented with dried chicory leave showed the best results especially that of 1% supplementation, concerning digestion coefficients, productive performance, blood parameters as well as hematological profile.

Keywords | Goats, Chicory, Digestibility, Productive performance, Blood

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INTRODUCTION

Over the past decades till now, animal production has been undergone of an enormous expansion throughout the world. Therefore, there is great interest to establish a more reliable and efficient feeding technique to improve nutrients digestibility and productive performance of all animal classes. Yet, there is a new globally direction that can using natural sources such as medicinal plants as feed additives which contain phytogentic contents (antibacterial, anticancer, antioxidant, antiviral and antifungal) those having beneficial effects on health condition and productive performance for ruminant animals. Also feed additives could be meet consumer's expectations to providing them

with safety food without harmful effects on environmental conditions or human health (Das et al., 2016; Walter, 1995).

Recently, results of studies conducted on herb mixture showed that such dietary treatment can be having a positive effect on the animal's performance (Brzóska, 2010). One of the most important herbage is chicory which is belonging to the family *Asteraceae* and native to Mediterranean area in Egypt, Europe, North America, Italy and West Asia; it looks bright blue lavender, white or pink flowers. There are many commercial vegetable varieties of chicory as (Bruxelles chicory, Treviso red chicory, endive) which considerably have an economic value. Chicory (*Cichorium intybus* L.) is a fibre-rich plant and grown especially for the main active components (inulin, fructans and fructooligosaccharides) and it considered as the best prebiotics capacity sources for the domestic animals forage (Castellini et al., 2007), which have a beneficial effects on metabolism of lipid and carbohydrates. The bioactive compounds like polyphenols and flavonoids that represented by kaempferol glycosides and quercetin as well as caffeic acid derivatives in wild chicory could be responsible for the antioxidant properties that having potential amendatory role in productive performance of animals (Di Venere et al., 2009) and also it can be reduce the intestine infections in grazing animals (Marley et al., 2003). Moreover, it is well known from the literatures since the 17th century that potentially used chicory herb as an important medical herbs and used in medicine department for gallstones, inflammations of the urinary tract and for liver lesion.

Chicory forage is a good quality and highly palatable feedstuff and containing minerals with good digestion for poultry and livestock (Scharenberg et al., 2007). Recently, Castellini et al. (2007) and Attia et al. (2014) demonstrated that chicory (root and forage) are of interest as fiber source in poultry nutrition. The different parts of the medicinal plants have provided animal rations with definite antioxidant components, pro-vitamin A and vitamins C and E. The objective of this study was to investigate the effect of supplemented dried chicory leaves in the ration of Balady kids on their growth performance, some blood biochemical parameters and hematological profile as well as the digestibility of the treated experimental rations.

MATERIALS AND METHODS

Ethical Approval

This experiment was carried out according to the guidelines of the ethical committee of Animal Production Research Institute. The current work was carried out in the goats Research Unit, Sakha Research Station, Kafr EL-Sheikh province, that belonging to Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt.

Experimental design

An abundant amount of dried chicory herb leaves (DCHL) was collected directly after harvested and chopped to 1-2 cm pieces with moisture content approximately 80%, then sun air dried for two weeks and then completely grounded before mixing with the other ingredients and stored until chemical analysis. Samples of feed ingredients were analyzed for crude protein, crude fiber, ether extract and ash. Proximate analysis was performed according to the methods of AOAC (2007). Chemical analysis of the experimental concentrate feed mixture (CFM), berseem hay, chicory leaves and calculated composition of experimental rations (on DM basis, %) are presented in Table (1).

Housing and feeding treatments

A total of twenty four growing Balady kids were chosen after weaning at three months of age for using in a feeding trial. Kids were individually divided randomly into three homogenous groups (8 kids each) according to their an average initial live body weight (15.40±1.99 kg) at started point of the feeding trial, using complete randomized block design. Dried chicory (*Cichorium intybus* L.) leaves which classified as medicinal plants herbs was formulated with the other ingredients in kids rations to evaluate its effects on nutrient digestion coefficients, productive performance of kids, some blood parameters and hematological profile. The trial period was lasted up to 90 days from weaning phase. An amounts of concentrate feed mixture (CFM) were daily introduced for all animals' groups that accounted by 3.5% of body weight in order to covering the nutritional requirements for growing kids according to the recommendation of NRC (1989). For preparing the dietary treatments, all experimental kids were fed diets consisted of concentrate feed mixture (CFM) and berseem hay (BH) with rate of 60:40, respectively. Animals in the first group were fed the diet without any additives and served as (control treatment, G0). While the other two tested groups (G1 and G2) were provided with (DCHL) with rate of 1.0 and 2.0 % levels as replacement of BH in control ration, respectively. Kids were fed twice daily in two equal portions (at 8 a.m and at 6 p.m.). Fresh water was freely available for each animal all the day time as well as mineral salts blocks for licking to covering their needs. The CFM was adjusted biweekly according to the change in animals, live body weight (LBW). Experimental animals were weighed biweekly before morning feeding after17 hrs as a fasting periods. Daily dry matter intake and live body weight (LBW) were recorded and dependently live weight gain (LWG) and feed efficiency (FE) were determined by calculation.

Table 1: Chemical analysis of the experimental, concentrate feed mixture, berseem hay and chicory leaves, and calculated composition of experimental rations (on DM basis, %).

Item	DM	OM	CP	CF	EE	NFE	Ash
Concentrate feed mixture	88.97	95.17	15.66	11.29	4.65	63.58	4.83
berseem hay	85.44	82.5	15.15	28.48	2.24	36.63	17.49
DCHL	90.15	88.67	15.24	17.13	3.42	52.88	11.33
Experimental rations:							
G0	87.63	90.35	15.47	17.84	3.73	53.32	9.65
G1	88.16	90.93	15.40	16.75	3.86	54.93	9.07
G2	88.67	91.50	15.34	15.69	3.99	56.49	8.50

Ingredients of CFM: Concentrate feed mixture contained yellow corn 35%, un decorticated cotton seeds 25%, wheat bran 33%, molasses 3%, minerals and common salt 1%, lime stone 2%. G0, control ration, G1, with 1% and G2, with 2% chicory leaves. DM: dry matter, OM: organic matter, CP: crude protein, CF: crude fiber, EE: ether extract, NFE: nitrogen free extract.

During the trial period, animals' health care was observed regularly by a veterinarian and animal keeping specialists.

Digestibility trials

Three digestibility trials were carried out simultaneously with the same kids of the feeding trials with three kids per each group (G0, G1 and G2), where they were fed individually in metabolism cages to facilitate the collection of all feces throughout the trials as well as feed intake was recorded daily. Water was available free all the day. The duration of each was lasted for 30 days where the first 23 days were considered as an adaptation period followed by 7-consecutive days for total collection one. Fecal samples were collected twice daily of nearly 200 g taken at (8.00 a.m and 6.00 p.m) as described by Maynard et al. (1979). Then 10% sulphoric acid (H_2SO_4) was added to the representative samples of feces before drying in the oven (at 65 ˚C) overnight. Daily feces samples for each kids were frozen immediately and stored at (-20 ˚C) till the end of the collection phase, and then composited samples for each animal was prepared for the chemical analysis. Samples of feedstuffs, CFM, BH, DCHL and the feces samples were dried in oven at 65 ˚C for 24 hrs then grounded to pass through (1mm screen) and its chemical composition were determined according to AOAC (2007). Digestion coefficients of nutrients and feeding values were calculated according to Abou-Raya (1967).

Blood parameters

Three months after the beginning of the feeding trial, blood samples were collected from external juggler vein in the morning prior feeding into two test tubes with potassium salt of EDTA (anticoagulant agent) for each animal (three kids / group). One of blood samples taken were centrifuged soon after collection at 3000 r.p.m for 20 minutes to obtained plasma then transferred into a clean dried glass vials. The supernatant was frozen stored at -20 ˚C untill subsequent chemical analysis. All biochemical blood constituents were determined using spectrophotometer (Spectronic 21 DUSA) and commercial diagnostic kits (Combination, Pasteur Lap.). The other blood samples were collected in heparinized-coated sterile tubes to obtain whole blood samples for determined the hematological parameters including mean of corpuscular volume (MCV%), using microhematocrit centrifuge at 4000 r.p.m for 15 min as reported by (Mitruka and Rawnsley, 1977), hemoglobin concentration using cyanomethemoglobin technique by (Mitruka and Rawnsley, 1977). Red blood cells (RBCs) and white blood cells (WBCs) counts were immediately estimated per mm3 from fresh blood using hematocytometer according to Mitruka and Rawnsley (1977).

Statistical analysis

The obtained data were statistically analyzed using one-way analysis of variance procedure (SAS, 2000) computer program using the following fixed model:

$Yi = \mu + Ti + ie$

Where Yi = The individual observation; μ = Overall mean; Ti = Effect of treatments. (i = 1, 2 and 3) and ie = Random error component assumed to be normally distributed. Significant differences between treatment means were determined at ($P<0.05$) by Duncan's multiple-range test (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition

Proximate chemical analysis of different rations, ingredients as well as the calculated composition of the experimental rations is given in Table (1). Data revealed that considerably similarities in the chemical composition between berseem hay and DCHL being 15.15 and 15.24% as crude protein CP on (DM basis), respectively. The present results respecting chicory CP and ash values are within the range that published by Monti et al. (2005), being (8.56 to 15.73 %) and (9.58 to 13.75 %) respectively. While, CP content here was markedly lower than that reported by (Wang and Cui, 2011) in cultivar of (Puna) chicory leaves (20.33%).

The same authors added that chicory forage is practically have similar proportions for CP, lipid, minerals and other nutrients in comparison to those of lucerne forage (Wang and Cui, 2011). While, Zhang et al. (2005) cleared that protein in chicory have been considerably a high quality nutrient that contains a lot of diverse amino acids and in which 9 requiring for the human and animals and (for example) the lysine had 1.2 % in chicory versus 1.05 ~ 1.38 % in alfalfa forage. Respecting berseem hay, its percentage values of CF, EE, NFE and ash being 28.48, 2.24, 36.44 and 17.49 were significant higher than the corresponding of 17.13, 3.42, 52.88 and 11.33 for chicory leaves, respectively. The content of CF% here had 17.13% that was extremely lower than that obtained by Wang and Cui (2011) in chicory forage being 26.83% which cleared to be identical to alfalfa (28.89%). Result cleared that content of EE had 3.42% was comparable to that observed by Wang and Cui (2011) who reported 3.78% with chicory forage and higher than that of average values of 10 varieties of alfalfa forage which recorded 2.99%. Ash content DCHL in present study (11.33%) was markedly lower than that recorded by (Wang and Cui, 2011) being 14.91% for chicory forage.

Wang and Cui (2010) reported that chicory forage had rich in carotene, ascorbic acid and minerals like Ca, P, Na, K, Fe, Mg, S, Mn, Cu, Se, Sr and Zn.

Among the favorable properties of chicory forage that appeared to be have fewer structural carbohydrates content and less dry matter and it can stay green longer than the other kinds of forage, thus, chicory has been embraced by farmers (Sitzia et al., 2006).The chemical composition of the concentrate feed mixture (CFM) was obviously to be with the normal values that published in the literatures and commonly practiced in the forms.

Digestibility coefficients and feeding values

The digestibility coefficients and feeding values of the experimental rations are presented in Table (2). Results showed significant effect (P<0.05) in digestion coefficients for most nutrients due to dietary supplement. Results revealed that nutrient digestion coefficient and feeding values were significantly (P<0.05) higher with 1% (G1) or 2%-DCHL (G2) compared to those of control one in respect of CP, OM, CP, CF and EE While, insignificant difference in digestibility of DM and NFE were observed among the dietary treatments, being the highest with G1. The feeding values expressed as TDN and DCP were related to digestion coefficient of nutrient where they kept the same way, being ranged from 64.19 to 68.55 for TDN and 10.23 to 10.98 for DCP (Table 2).

Recently Mahmoud (2021) pointed that dairy goats fed diet containing 1% chicory leaves (CL) was significantly (P<0.05) the highest in respect of digestibilities of DM, OM, CP and NFE followed by ration that contained 2% (CL), while the lowest value was obtained with the control one. The same author observed that the digestibility of crude fiber was significantly (P<0.05) increased, while digestion coefficient of ether extract was insignificantly (P>0.05) increased with increasing the level of CL herb based on control diet. Also, El-Basiony et al. (2015) demonstrated that inclusion of *Chicorium intybus* L. at rate of 10 g in dairy goat rations could be increase the digestibility coefficient of all nutrients (DM, CP, OM, EE. CF and NFE) in corresponding with those of control diet, that might be owing the ability of chicory (*Chicorium intybus* L.) to purge of the digestion pathway from the parasites that may affect negatively the rumen environmental balance and in turn such effect could be reflected on the processes of digestibility of the feed nutrients appropriately (Athanasiadou et al., 2007). Hanafy et al. (2009) with Barki lambs mentioned that the addition of some medicinal herbage into animals' diets has a positive effect on nutrient digestibility coefficients and feeding values of the supplemented diet. And it can be improved rumen fermentation and consequently the digestion coefficients of different nutrient (Ando et al., 2003). Physiologically, medicinal herbs could be act as a metabolic regulation, stimulate the digestive processes and had anti-stress properties and also enhance the animal production quality (Bhatt et al., 2000).

Also, Abou-Zied (1988) noticed that medicinal herb plants comprises bioactive substances which doing as antiseptic against the antagonistic germ and capable of stimulating enzymes and the digestive tract processes. Virtually, the proportions of 70% (leaves) and 30% (stems) could be desirable for chicory forage in order to the digestibility of leaves was markedly higher than the stems (Clark et al., 1990). On the other hand, Socode (2011) demonstrated that rabbits fed diets contained apple, citrus or beet pulp as a soluble or digestible sources of fiber could be replaced by chicory pulp which recognized for its high content of minimum (inulin 7% and pectin 27%). The same author cleared that chicory pulp product can be obtained by a partial extraction of inulin by the diffusion of chicory root pieces. Also result of this study presented that chicory pulp is contains an average 87 % DM, 8.8 % CP, 32.0 % NDF, 24.0 % ADF and 2.0 % ADL. Generally, Scharenberg et al. (2007) concluded that the chicory forage is considered as a highly palatable, a good source of minerals and good digestion of different nutrients for poultry and livestock, and it is good quality plant with a positive influence on dairy performance with grazing ewes (Di Grigoli et al., 2012). A prebiotic like inulin or lactulose has been defined as a non-digestible substance that beneficially affects the host by modulation of the intestinal flora (Gibson and Roberfroid, 1995).

Table 2: Effect of experimental rations on digestion coefficients and feeding values.

Item	Experimental rations			± S.E
	G0	G1	G2	
Digestion coefficients:				
DM	64.45	67.14	65.79	±0.602
OM	67.23 [b]	71.29 [a]	70.18 [a]	±0.694
CP	66.10 [b]	71.30 [a]	69.73 [a]	±0.833
CF	51.17 [b]	57.94 [a]	56.81 [ab]	±1.38
EE	72.81 [b]	76.496 [a]	75.07 [a]	±0.622
NFE	72.62	75.05	73.70	±0.606
Feeding values: On DM basis				
TDN	64.19 [b]	68.55 [a]	67.97 [a]	±0.757
DCP	10.23 [b]	10.98 [a]	10.69 [a]	±0.120

a and, b means in the same row with different superscripts are significantly ($P \leq 0.05$) different.
= G0, control ration, G1, with 1% and G2, with 2% chicory leaves. DM: dry matter, OM: organic matter, CP: crude protein, CF: crude fiber, EE: ether extract, NFE: nitrogen free extract, TDN: total digestible nutrients, DCP: digestible crude protein.

Growth performance

Data regarding feed intake, live body weight, daily gain and feed conversion ratio are presented in Table 3. Results revealed that insignificant differences in initial live body weight (LBW) among treatments at 3 months of age and ranged between 15.40 to 15.55 kg / kid. In Perspective, kids in G1 fed diet contained 1% (DCHL) showed the highest ($P<0.05$) final live body weight, total and daily weight gain followed by G2 that fed diet supplemented with 2% (DCHL), while the control one (G0) had the lowest values. These results are in agreement with those obtained by Mahmoud (2021) in which suckling kids received 1% chicory leaves (CL) recorded the highest ($P>0.05$) LBW and total weight gain at each age intervals compared with the rations contained 2% (CL) and control group, with no significant effect on kid's birth weight among dietary treatments. Also, Laws and Genever (2013) illustrated that lambs grazing on chicory forage have a similar growth rate to those lambs fed on legumes forage and preferable growth performances than those lambs grazing grass based pastures and furthermore, they added that, the ratio of growth can be reach to 70 % higher for lambs grazing chicory forage compared with those fed standard level of grass sward. Also, SooBo (2005) reported that using inulin or chicory to rations as additives were led to a positive effect on growth performance for monogastric animals (chicken, pig, rat and rabbit) in particularly with the young animals and in addition the chicory roots or forage also considered as a good source of fiber in nutrition of poultry as reported by (Attia et al., 2014). Earlier, Boraei et al. (2013) recommended that addition of medical herbs to rations of growing lambs as feed supplements could be enhance daily gain, improved ruminal measurements and as well as maximize the net profit. Similarly, Allam et al. (2007) worked on Zaraibi kids and emphasized a utilization of some medical plant like mint, blackseed, chamomile and anise seeds as feed additives, where they led to a positive impact on meat quality, growth rate and economic efficiency. Also, Wawrzyńczak et al. (2000) mentioned that the best finding values of body weight gain and feed intake were observed with calves received a concentrate feed mixture supplemented with 1% than that of 0.5% levels of some medicinal herbs i.e., *Hypericum perforatum*, *Melissa officinalis*, *Chamomilla recutita* and *Urtica dioica* compared with those fed the free one. Also, Stenzel et al. (2000) estimated that applying reduced amounts of medical herbs extracts to calves diets could be reflect a good growth performance and development during the period from 2nd week of life till puberty. While, Ivarsson et al. (2011) estimated that introducing up to 160 g chicory (*C. intybus*) /kg diet did not negatively effect on weaned piglets performance and could be considered as beneficial feedstuffs for these animals. Furthermore, Volk and Marounek (2011) found that insignificant differences in daily weight gain was found between rabbits groups fed on control or chicory root-ration inclusion.

Feed consumption and feed conversion

Results of feed intake and feed conversion by kid's goat during the experimental period are presented in Table (3). The obtained results cleared that feed intake (FI) as DMI, total digestible nutrient intake (TDNI) and digestible crude protein intake (DCPI) seemed to be significantly ($P<0.05$) higher for kids received 1%-DCHL (G1) than those on other tested diet (G2) and the control one (G0), being (779±8.82 g), (496±6.07 g) and (76.89±0.994 g) for 1%-DCHL diet (G1), respectively, with no significant ($P>0.05$) differences between G0 and G2 respecting only DMI and DCPI and between G1 and G2 in respect DMI. In relation to the present results, Boraei et al. (2013) recommended that addition of medical herbs to rations of growing lambs as feed supplements could be improved

Table 3: Average daily gain, feed intake and feed conversion of kids fed the experimental rations.

Item	Experimental rations			± S.E
	G0	G1	G2	
Initial BW (kg/h)	15.40	15.55	15.25	± 0.199
Final BW (kg/h)	26.35 [b]	28.78 [a]	27.32 [ab]	± 0.475
Total gain (Kg/h)	10.95 [b]	13.23 [a]	12.07 [a]	±0.383
Daily gain (g/h)	122.0 [c]	147.0 [a]	134.1 [b]	± 3.64
Dry matter intake (g/h/d):				
CFM	438	465	447	
BH	292	310	298	
Chicory	-	3.1	5.96	
TDMI	730 [b]	779 [a]	751 [ab]	±8.82
TDNI	456 [c]	496 [a]	483 [b]	±6.07
DCPI	70.74 [b]	76.89 [a]	72.55 [b]	±0.994
Feed conversion:				
DMI Kg / gain Kg	5.98 [a]	5.30 [b]	5.60 [b]	±0.108
TDNI Kg / gain Kg	3.74 [a]	3.37 [b]	3.60 [ab]	±0.073
DCPI Kg / gain Kg	0.579 [a]	0.523 [b]	0.541 [b]	±0.010

a and b means in the same row with different superscripts are significantly ($P \leq 0.05$) different.
G0, control ration, G1, with 1% and G2, with 2% chicory leaves. BW: body weight, CFM: concentrate feed mixture, BH: berseem hay, TDMI: total dry mater intake, TDNI: total digestible nutrient intake, DCPI: digestible crude protein intake.

their feed intake. Otherwise, earlier results that conducted by Minnee et al. (2017) revealed that integration up to 20 or 40% chicory (*C. intybus* L.) to dairy cattle ration using grazing system could be decrease milk yields and DMI in comparison with animal's grass-based swards ration at late lactation. While, Volk and Marounek (2011) found that insignificant differences in feed intake were found between rabbits groups fed the control diet or those fed chicory root-ration. Also, Ivarsson et al. (2011) estimated that non-significant differences in feed intake for weaned piglets fed a cereal-based diet integrating either ribwort *Plantago lanceolata* L. or chicory *C. intybus* forages.

Concerning the feed conversion (FC) trait as shown in Table (3), results demonstrated that feed conversion was markedly improved in both tested rations in comparison with the control one, being the best values that expressed as DMI Kg/gain Kg, TDNI Kg/gain Kg and DCPI Kg/gain Kg were found with kids fed ration contained 1% chicory herb followed by the 2% herb-ration compared with those of the poorest one that occurred with the control diet that free from chicory (G0). The present results are supported by Boraei et al. (2013) who cleared that utilization of medical herbage when added into growing lamb rations as feed supplements could be increase the daily gain, feed intake, feed utilization and as well as maximize the net profit (value/kg gain). Also, Guermah and Maertens, (2012) resulted that the feed conversion ratio was significantly ($P<0.05$) improved in case of weanlings rabbits, that received 20% chicory pulp compared with those fed the control ration. Otherwise, Volk and Marounek (2011) showed insignificant difference in feed conversion ratio for rabbits fed diets contained chicory root compared with those fed the control ration. Also, Ivarsson et al. (2011) found that there were non-significant effects respecting feed conversion ratio for weaned piglets fed diet contained ribwort *Plantago lanceolata* L. or chicory *C. intybus* forages. There is a great direction to potentially using medicinal herbs as vital feed additives to manipulate ruminal fermentation and also improvement the ruminants feed efficiency (Wang et al., 2000).

Blood biochemical parameters

Blood plasma parameters of kids fed the experimental rations are shown in Table (4). Results revealed that significant differences ($P<0.05$) in particularly between G0 and G1 in respect of all measured items in blood. Animals of G1 had the highest ($P<0.05$) concentrations of plasma total protein (TP), albumin and globulin (G), whereas, the lowest value was recorded with the control group (G0). Opposite trend was noticed among the dietary treatments with the measurement of glucose, total cholesterol, uric acid and creatinine concentrations, being the highest ($P<0.05$) with control ration (G0), followed by corresponding values of 2% DCHL-ration (G2) than the lowest values those occurred with 1% DCHL-ration (G1).

Finally, liver activities of Aspartate (AST) and Alanine (ALT) aminotransferase enzymes were significantly ($P<0.05$) higher for kids received the low level of chicory

herb (G1) and insignificant higher for group received the high level of herb (G2) in comparison with those of control ration (G0). In general, the total proteins and albumin concentrations in the blood plasma is directly responding to the quality and intake of protein in the ration (Onifade and Abu, 1998). Increasing total protein and albumin in tested groups might be due to the increased digestibilities of crude protein and organic matter in these nutrients. The present results are on line with those obtained by El-Basiony et al. (2015) who showed that slightly increases of blood serum total protein and globulin concentrations, while, concentrations of cholesterol and urea were slightly decreased in dairy goats fed diet contained 10 g *C. intybus* as feed additives compared with those of control one. The same authors added that goats fed control diet had significantly (P<0.05) the highest creatinine concentration compared with those fed on 10 g *C. intybus* supplement. Similarly, Allam et al. (2007) cleared that plasma total lipids and cholesterol concentrations were decreased (P<0.05) significantly with Zaraibi kids fed diets contained some medicinal plant herbs as chamomile, blackseed, mint or anaise seeds as feed additives. Also, Behboud Jafari et al. (2011) reported that serum total cholesterol, LDL and triglycerides concentrations were significantly (P<0.05) decreased in broiler chickens fed on basal diet + 200 ppm of both black seed *Nigella sativa* and chicory *C. intybus* extract compared with those fed non-supplemented one (control). Pointedly, Wang and Cui (2009) recorded that chicory *C. intybus* comprised of highly bioactive compounds like triterpenes, alkaloid, organic acid, sesquiterpenes, saccharides, coumarins, etc. and those working considerably as a vital metabolic activities, which could be lowering the concentrations of blood glucose and lipid and also decreasing uric acid for ruminants. Otherwise, earlier results conducted by Mahmoud (2021) revealed that concentrations of total protein, albumin, globulin, activities of aspartate (AST) and alanine (ALT) aminotransferase enzymes, glucose and total cholesterol were unaffected (P>0.05) significantly by the addition levels of chicory herb into the rations of lactating goats compared with those of control one. Similarly, Chaturvedi et al. (2013) showed that there were non-significant differences in blood glucose and urea-N levels in Barbary kids fed diet containing 0.5% from some herbal mixture inclusion was prepared from roots of *Curcuma longa*, small stems and leaf of *Ocimum sanctum*, fruits of *Emblica officinalis*, small stem and leaves of *Clerodendrum phlomidis* and leaves of *Azadirachta indica* compared with control one in a feeding trial. On the other hand, El-Basiony et al. (2015) revealed that slightly increases of blood serum glucose concentrations, while, concentrations of albumin, ALT and AST were slightly decreased in dairy goats fed diet enriched 10 g *C. intybus* as feed additives compared with the control ration.

Physiologically, Craig, (1999) emphasized that albumen considered as one of the significant proteins that protect the osmotic pressure stabilized in the blood and improving the health of animal production. Also, Stroev, (1989) showed that albumen and globulin can be reflect the ability of animals in storage reserve proteins even after their bodies have a maximum of deposit tissues capacity. Data appeared that no pathological harmful in the liver that being the main organ of albumin synthesis, which has been revelation to be a good pointer of nitrogen state, in particularly in small ruminants which are reflected on animal performance status (Laborde et al., 1995). Thus, potentially the increasing in globulin production by the liver could be reflect a good hepatic enzymatic function of these animals and led to a high immunity (Griminger, 1986).

Hematological profile of kids

Results of hematiological measurements for kids fed the experimental rations are presented in Table 5. Statistically significant differences in hematological profile between the tested ration and the control one were found on most studied parameters (P<0.05). The integration of DCHL with the experimental kids ration by 1% as feed additives had a positive impact on their most hematological measurements as increasing the levels of hemoglobin concentration (Hb), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC) based on control one (G0). Meanwhile, the differences between G2 and G0 did not differ (P>0.05) significantly in respect of the MCV and MCH or between G1 and G2 treatments respecting MCHC values. While, Masanetz et al. (2011) found that the calves fed diet contained 2% inulin gave significantly (P=0.003) higher hemoglobin and hematocrit % than that of 2% lactulose and control one.

Regarding, red blood cells (RBCs) count and Hematocrit (Hct) %, results revealed that non- significant change (P>0.05) due to the addition of different levels of (DCHL) for balady kids diets based on control ration that have zero addition (G0). Similarly, Bombik et al. (2012) recorded that there were non-significant effect respecting hematocrit level with calves' received 20% mixture of water herbal extracts compared with those fed the free one. While, Chaturvedi et al. (2013) estimated that the value of RBCs was increased (P<0.01) marginally in Barbary kids fed diet containing 0.5% from some herbal mixture that prepared by equally proportion of each roots of *Curcuma longa*, small stems and leaf of *Ocimum sanctum*, fruits *of Emblica officinalis*, small stem and leaves of *Clerodendrum phlomidis* and leaves of *Azadirachta indica* compared with control that free from such supplements at (21) days, but the values of RBCs did not affected significantly (P>0.01) at 170 days of feeding period. Also, they showed that the

Table 4: Effect of experimental rations on blood parameters of kids

Item	Experimental rations			± S.E
	G0	G1	G2	
Total protein (g/dl)	8.44 [b]	8.73 [a]	8.54 [b]	±0.035
Albumin (g/dl)	4.37 [c]	4.48 [a]	4.42 [b]	±0.033
Globulin (g/dl)	4.07 [b]	4.25 [a]	4.13 [b]	±0.007
Glucose (mg/dl)	79.96 [a]	69.43 [b]	76.86 [a]	±1.57
Cholesterol (mg/dl)	155.0 [a]	134.4 [c]	143.1 [b]	±1.52
Uric acid (mg/dl)	4.53 [a]	3.68 [b]	3.89 [b]	±0.120
Creatinine (mg/dl)	1.53 [a]	1.21 [c]	1.35 [b]	±0.010
Activities of AST (U/I)	30.67 [b]	35.0 [a]	32.3 [a b]	±0.860
Activities of ALT (U/I)	21.67 [b]	26.0 [a]	23.00 [a b]	±1.17

a and b means in the same row with different superscripts are significantly (P ≤ 0. 05) different.
G0, control ration, G1, with 1% and G2, with 2% chicory leaves.

Table 5: Hematological parameters of kids fed the experimental rations.

Item	Experimental rations			± S.E
	G0	G1	G2	
Hemoglobin (Hb) g %	7.2 [c]	8.50 [a]	7.80 [b]	±0.145
Red blood count (RBCs) 10^6/cmm	3.50	3.40	3.50	±0.027
Hematocrit (Hct) %	23.0	24.0	23.0	±0.252
Mean Corpuscular Volume (MCV) fl	66.0 [b]	71.0 [a]	66.0 [b]	±0.708
Mean Corpuscular Hemoglobin (MCH) pg	21.0 [b]	25.0 [a]	22.0 [b]	±0.504
Mean Corpuscular Hemoglobin Concentration (MCHC) gm %	31.0 [b]	35.0 [a]	34.0 [a]	±0.532
White blood count (WBCs) 10^3/cmm	2.80 [b]	3.70 [a]	3.60 [a]	±0.109
Neutrophils (N) %	66.0 [b]	63.00 [c]	68.0 [a]	±0.549
Lymphocytes (L) %	30.0	31.00	30.0	±0.270
Monocytes (M) %	3.00 [b]	4.00 [a]	3.00 [b]	±0.126
Eosinophils (E) %	1.00 [b]	2.00 [a]	2.00 [a]	±0.126

a, b and c means in the same row with different superscripts are significantly (P≤0. 05) differ
G0, control ration, G1, with 1% and G2, with 2% chicory leaves

values of Hb, HCT%, MCH and WBCs were significantly unaffected (P>0.01) over the whole experimental period (170 days) for Barbary kids. Data in the present study showed that the percentages of differential white blood cells (WBCs) count and leukocytes (Eosinophils %) were mostly significantly (P<0.05) higher in tested rations that contained either 1% or 2% (DCHL) comparing with those of control that free from such supplements (G0). Also, results of the present study showed that the percentage of monocytes to total leukocytes was significantly (P<0.05) higher for kids received low level of chicory (G1), while the lower values were occurred with either those received high level of chicory (G2) or those of control one (G0). Also, results showed that non-significant differences (P>0.05) respecting the percentage of lymphocytes amongst the different dietary treatments of the experiment. Otherwise, Masanetz et al. (2011) found that monocytes % was decrease (P50.073) in both prebiotic tested groups which having (2%) of inulin or lactulose of calves in comparison with the control group. Additionally, Bombik et al. (2012) recorded that calves fed diet containing a mixture of water herbal extracts at rate of 20% from *Hypericum perforatum*, *Urtica dioica, Melissa officinalis, Chamomillae recutita, Plantago lanceolata,* and *Calendula officinalis* showed a significantly (P<0.05) higher of RBCs count, concentration of the hemoglobin and mean corpuscular volume, and significantly (P<0.05) lower of (WBCs) count comparing with those of control ration that free from the herbal extracts. Thus, the herbal feed additives didn't adversely effect on the blood hematology profile in growing Balady kids.

CONCLUSION

In conclusion, addition of 1% dried chicory herb leaves into the ration of growing kids could be used to improve digestion coefficient, hepatic function, growth performance

as well as blood parameters and hematological profile of growing kids.

CONFLICT OF INTEREST

The author declared there is no conflict of interests.

NOVELTY STATEMENT

The results declare that Cichorium Intybus is considered as antioxidant and anticancer properties which affected positively the productive performance of growing kids.

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