Research Article

Ceratophyllum demersum Weed as a Dietary Protein for Iraqi Awassi Sheep

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Abstract | *Ceratophyllum demersum*, commonly known as coontail or hornwort, is a submerged aquatic plant native to many parts of the world. *C. demersum is* used in aquaria and pond gardens for its fast growth rateability to improve water quality by excess nutrients, and toxins, and can be included in the sheep diet as a protein source at certain levels. The study was conducted in Karbala province, using the Al-Husseiniya River as the source of *C. demersum*. A total of 40 Awassi sheep were divided into two groups. The experimental group received a diet containing *C.demersum* as the primary protein source, while the control group had natural grass grazing as the basal diet. The results revealed that weight gain, final weight, fat tail weight, hemoglobin, packed cell volume, glucose, and total protein of the experimental group was significantly ($P < 0.05$) higher than that of the control group A diet containing *C. demersum* has the potential as a protein source with a significant ($P < 0.05$) positive effect on the growth performance and hematological and biochemical parameters of Iraqi Awassi sheep and warrants further investigation to determine optimal levels of inclusion.

Keywords | Awassi sheep; Body measurement; *Ceratophyllum demersum*; Growth traits; Protein.

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INTRODUCTION

Aquatic plants can be harmful to public health, agriculture, fisheries, and navigation. They contribute significantly to the organic production of the majority of inland water systems, release oxygen into the air, and improve water aeration. Some hydrophytes remove hazardous substances by adsorption from the water and higher bottom sediments, stabilizing the bottoms, and preventing bank erosion (Alprol *et al*., 2021). Fish, waterfowl, and other aquatic species can also find refuge and food from aquatic plants, some of which serve as hosts for numerous epiphytes and serve as sources of paper pulp, fiber, and bioenergy. Birds consume numerous species of *Ceratophyllum*, *Lemna*, and *Potamogeton* (Gurnell, 2014). Hydrophytes also benefit the environment by soil stabilization, nitrogen cycling, water filtration, and a source of food for terrestrial organisms like humans and birds (Roopika & Siddhuraju, 2022). Other applications for freshwater weeds include biogas production, fuel, fertilizer, soil additives (mulch), mushroom cultivation, paints, the reduction of paper-pulp mills and tanneries water pollutants, and the rubber and oil palm industries (Basiron, 2007). Aquatic plants are an efficient and affordable water purification method (natural filters) in rivers or lakes. Aquatic plants have been widely used in recent years practically everywhere in the world to clean polluted water (Pang *et al*., 2023). Aquatic plants are crucial in the sequestration of significant amounts of metals and nutrients from the environment by storing them in the roots and/or shoots (Agathokleous *et al*., 2019). Because of their rapid development and high biomass production, aquatic plants have a significant potential for the remediation of macronutrients. To determine the potential for nutrient and metal removal via plant uptake and harvesting, it is crucial to study the seasonal and regional fluctuations in plant accumulation in wetland systems. *Ceratophyllum demersum* (coontail or hornwort) can be found in its natural habitat in some different parts of the world. It is a popular option for use in aquariums and pond gardens as it has a high growth rate and the ability to improve water quality by absorbing excess nutrients and impurities (Bhateria & Jain, 2016). This makes it an ideal plant for use in these types of environments. In aquatic ecosystems, *C. demersum* is characterized as a weed. This is because it has a rapid growth rate and can outcompete native plant species in certain circumstances (Houlahan & Findlay, 2004). It has been observed sometimes to develop into dense monotypic stands, which have the potential to change the physicochemical properties of the water, as well as throw off the natural equilibrium of the environment. *C. demersum* is typically regarded as a weed that should be avoided in aquatic environments including lakes, reservoirs, and irrigation systems since it can be a nuisance (Vörösmarty & Sahagian, 2000). Swimming and other water-based recreational activities like boating may become more difficult to enjoy, and the aesthetic value of bodies of water may lose some of their allure as a result. In addition to this, *C. demersum* can negatively block water intake structures and impair the normal operation of hydroelectric generating installations (Komara *et al*., 2022).

Management measures for *C. demersum* may include either the physical removal of chemical herbicides application or the use of biological control methods. Nevertheless, before putting these tactics into action, it is vital to give significant consideration to the potential implications that they may have on the nearby ecosystem (Moore, 2006). *C. demersum* is a plant that is widely used in aquariums and pond gardens. This is because it has a high growth rate and can improve the overall quality of the water (Wu *et al*., 2021). On the other hand, it can rapidly develop and throw off the natural balance of the ecosystem; as a result, it is sometimes called a weed in aquatic environments. This is because it can disrupt the natural equilibrium of the ecosystem. It may be necessary to implement control measures to lessen the negative consequences, but before doing so, it is crucial to give significant attention to the potential repercussions that these efforts could have on the environment in the surrounding area (Auta *et al*., 2017). There has only been a limited amount of research conducted in Iraq on the use of *C. demersum* as a dietary protein for Awassi sheep. This is one of the most important questions that need to be answered. Despite this, there have been some studies to determine whether or not it is feasible as a feed component for sheep. These inquiries are now still being conducted. Including *C. demersum* in the sheep diet as a protein at levels of up to 20% does not have the animals' ability to grow or their feed efficiency. It was also observed that providing lambs with a diet that contained *C. demersum* at a level of 15% resulted in a higher growth rate, as well as improved feed conversion (Cao *et al*., 2021).

It is vital to keep in mind that research was conducted in a variety of geographical places, and the findings may not necessarily apply to Iraqi Awassi sheep. In addition, *C. demersum* is not a component that is typically utilized in feed, and consequently, additional research is necessary to comprehend its potential as a protein for Iraqi Awassi sheep. It is of the utmost significance to take into account the expense and accessibility of *C. demersum* as a component in feed. To fully grasp the potential of *C. demersum* as a protein for Iraqi Awassi sheep and to determine the appropriate levels of inclusion in the diet, additional research is required. In addition, it is vital to take into consideration the availability and cost of *C. demersum* as a component of animal feed, in addition to any potential negative effects on the natural environment that may be incurred. We aimed to study the potential of using the aquatic weed *Ceratophyllum demersum* as a dietary protein source in Iraqi Awassi sheep and the impact of including *C. demersum* in the diet on the growth performance and hematological and biochemical parameters of Iraqi Awassi sheep. The researchers wanted to determine whether *C. demersum* could be used as a protein source for these sheep and, if so, to identify any potential benefits or drawbacks of its inclusion in the diet.

MATERIALS AND METHODS

The study was conducted at Karbala University from May 2021 to April 2022 and followed international guidelines for animal care and use (Vet, No. 015,7,21). The research was carried out in the province of Karbala (Latitude: 32° 36' 24.6456" N, Longitude: 44° 0' 37.4112" E), with the Al-Husseiniya River serving as the primary supply of *C. demersum*. We used 40 Awassi sheep, who were divided into two groups (n=20 each). All animals were kept under the same management conditions with mean temperatures (24.19 °C) and relative humidity (46.75%). Animals were housed in 4 pens of sheep (10 animals per pen) of 4.1 m × 3.7 m. Expert veterinarians confirmed the included sheep to be clinically healthy. Feedstuffs were offered in two almost equal meals at 8 a.m. and 4 p.m. The control group was given a diet consisting of natural grass grazing as their primary source of nutrition, while the experimental group was given a meal that included *C. demersum* as the predominant source of protein. The growth performance and feed efficiency of the sheep were evaluated throughout the study (eight weeks). The growth performance of the sheep was evaluated by taking measurements of their body weight and their body condition score at the beginning and the end of the research project. The ratio of the amount of weight gained by the sheep to the total amount of dry matter consumed was used to assess the feed efficiency. After the research project, representatives of both the *C. demersum* and the wild grass were allowed to have their balanced diet should offer around (70% wild grass and 30% *C.demersum*) collected and evaluated for their proximate composition and nutritional content. The sheep's blood was collected from all animals via the external jugular vein, the first part (2ml) was used for a hematological examination, and the remaining part (3ml) was centrifuged for 15 minutes at 2,000 x g before being frozen at -20 °C for biochemical analysis. The data were evaluated by using the statistical software SPSS ver.25.0, and a t-test was used to compare and contrast the differences that were found between the two groups as the following model:

$Y_{ij} = \mu + T_i + e_{ij}$

where, Y_{ij}, phenotypic traits; μ, overall mean; T_i, the effect of the i^{th} study group, and e_{ij}, random error NID (0, σ2e).

RESULTS AND DISCUSSION

Providing Iraqi Awassi sheep with a diet that featured *C. demersum* protein source had a substantial impact on the growth performance of the animals (Gałczyńska *et al.*, 2019). In comparison to the control group, the experimental group ended up with a higher final weight, as well as greater weight gain and fat tail weight Table (1). There was a statistically significant gap between the two groups (Safdarian *et al.*, 2008).

It appears that including *C. demersum* in the diet of Iraqi Awassi sheep can improve their growth performance as evidenced by the fact that the experimental group had a greater final weight, weight gain, and fat tail weight. This was demonstrated by the fact that the experimental group had a higher total body fat percentage than the control group. More research is needed to fully understand the potential of *C. demersum* as a protein for Iraqi Awassi sheep and to determine the appropriate proportions of inclusion in the diet. In the meanwhile, you can try feeding your sheep a diet that includes both of these ingredients sheep feed ingredients levels three (Borisova *et al.*, 2014).

Administering a diet to Iraqi Awassi sheep that mostly consisted of *C. demersum* as the primary protein source had a significant effect on the hematological and biochemical profiles. The levels of hemoglobin (Hb), packed cell volume (PCV), glucose, and total protein were all significantly (P < 0.05) higher in the experimental group as compared to the group. These results were in agreement with (Javed *et al.*, 2016) who found alterations in hematological parameters for Channa punctatus like hematocrit (Hct), hemoglobin (Hb), and total erythrocyte (TEC) (Tiwari *et al.*, 2020). Table (2).

Table (1): Growth performance of the sheep between experimental and control groups.

Parameters	Experimental sheep LSM ± SE	Control sheep LSM ± SE	P value
Initial weight (Ibs)	36.92 ± 7.40	38.49 ± 4.10	P> 0.05
Final weight (Ibs)	62.47 ± 8.70	47.33 ± 7.90	P< 0.05 *
Weight gain (%)	38.58 ± 8.89	44.18 ± 8.90	P< 0.05*
Fat tail weight (pounds)	13.66 ± 4.67	7.95 ± 2.38	P< 0.05*

LSM ± SE, Least square means ± Standard error. P< 0.05* indicates a significant difference in the raw within each classification. P> 0.05 indicate a non-significant difference.

Table (2): Blood parameters between experimental and control groups.

Blood parameters	Experimental sheep LSM ± SE	Control sheep LSM ± SE	P value
Hb g/dl	11.16 ± 0.31	9.24 ± 1.49	P< 0.05*
PCV(%)	32.14 ± 6.79	29.38 ± 7.19	P< 0.05 *
ESR (mm/h)	0.63 ± 0.09	0.51 ± 0.08	P> 0.05
TLC (thousand/cumm)	8.31 ± 2.48	7.45 ± 1.16	P> 0.05
TEC (million/cumm)	8.2 ± 0.94	7.72 ± 1.51	P> 0.05
Lymphocyte (%)	59.31 ± 7.25	51.72 ± 3.92	P> 0.05
Neutrophil (%)	37.18 ± 4.18	32.17 ± 3.27	P> 0.05
Eosinophil (%)	5.26 ± 0.44	4.83 ± 0.11	P> 0.05
Monocyte (%)	2.16 ± 0.58	2.27 ± 0.17	P> 0.05
Basophil (%)	0.58 ± 0.03	0.42 ± 0.02	P> 0.05
Glucose (mg/dl)	44.59 ± 6.42	33.64 ± 5.24	P< 0.05 *
TP (g/dl)	7.92 ± 1.38	5.82 ± 1.19	P< 0.05 *

LSM ± SE, Least square means ± Standard error. P< 0.05* indicates a significant difference in the raw within each classification. P> 0.05 indicate a non-significant difference. Hb, hemoglobin; PCV, packed cell volume; ESR, erythrocyte sedimentation rate; TLC, total leukocyte count; TEC, total erythrocyte count; TP, total protein.

The experimental group had a hemoglobin level that was statistically (P < 0.05) significant compared to the control group (Roughton *et al.*, 1955). It was determined that the experimental group had a significantly (P < 0.05) higher packed cell volume (Abd-Allah *et al.*, 2019). The glucose level in the control group was significantly (P < 0.05) lower than that in the experimental group. The control group had a total protein level that was significantly (P < 0.05) lower than the experimental groups.

In terms of the erythrocyte sedimentation rate (ESR), the total leukocyte count (TLC), the total erythrocyte count (TEC), or the percentages of neutrophils, eosinophils, basophils, monocytes, or lymphocytes, there was not a significant difference between the two groups (Kyriazakis & Oldham, 1993). These findings suggested that including *C. demersum* in the diet of Iraqi Awassi sheep may be able to improve the hematological and biochemical profiles. This is corroborated by the fact that the concentrations of hemoglobin, packed cell volume, glucose, and total protein were significantly (P < 0.05) greater in the experimental group (Hawkins, 1984). To have a comprehensive understanding of the potential of *C. demersum* as a protein source for Iraqi Awassi sheep and to determine the optimal amounts of inclusion in the diet, additional research is required. You could, in the meantime, experiment with giving your sheep a diet that contains both of these components to see how they react to

CONCLUSION

Feeding a diet containing *Ceratophyllum demersum* as a protein source had a significant positive effect on the growth performance and hematological and biochemical parameters of Iraqi Awassi sheep. The experimental group had higher final weight, weight gain, fat tail weight, hemoglobin, packed cell volume, glucose, and total protein levels compared to the control group. *C. demersum* has the potential as a protein source for Awassi sheep and warrants further investigation to determine optimal levels of inclusion in the diet. However, it is important to note that the present study was limited in scope and further research is necessary to fully understand the effects of *C. demersum* on Awassi sheep and to confirm these results.

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CONFLICT OF INTEREST

None.

NOVELTY STATEMENT

This study is the first study using *Ceratophyllum demersum* to measure the growth performance of the Awassi sheep.

AUTHORS' CONTRIBUTION

Faris Sahib: Conceptualization, data analysis, interpretation, original draft, and review writing, as well as editing. Mohammed Mohsin: Data analysis, and interpretation, original draft, and review writing. Layth Hamzah: Analysis in the laboratory and verification of laboratory data.

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