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Effect of *Spirulina platensis* Microalga Additive on Performance of Growing Friesian Calves

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ABSTRACT

The current work was done to study the impact of supplementation *Spirulina platensis* alage into the rations of growing Friesian calves on feed intake, rumen fermentation activity, digestibility, growth performance and economic efficiency. Eighteen Friesian calves aged 12 months with initial live body weight of 219.06 ± 5.35 kg were divided into three groups for 150 days feeding trial. Calves were individually fed a basal ration composed of 50% concentrate feed mixture (CFM) + 30% corn silage (CS) + 20% rice straw (RS) on dry matter basis without supplementation (control, R1) or with 1 g (R2) and 2 g (R3) dry *Spirulina* alage/ head/ day. Results showed that calves fed R3 recorded significantly ($P<0.05$) the highest nutrients digestibility and feeding values compared with R2 and the control one (R1). Intake of total dry matter (DM), digestible crude protein (DCP) and total digestible nutrients (TDN) were nearly similar for the different groups. The concentration TVFA's was significantly higher, while pH values and NH_3-N concentration were significantly lower ($P<0.05$) in rumen liquor with the two *Spirulina* rations compared with the control one. Total protein concentration in plasma increased significantly ($P<0.05$) with *Spirulina* rations compared with the control one, while the rest of blood metabolities did not affected by the dietary treatments. Final live body weight, total and daily weight gain, as well as the improvement of daily gains were significantly higher ($P<0.05$) for the high level of dry *Spirulina* compared with the low level of dry *Spirulina* and also the control one. Feed conversion as DM, TDN and DCP required for producing one kg weight gain were lower significantly ($P<0.05$) for calves with *Spirulina* rations compared with those of control. Average feeding cost was nearly similar for the different groups. Whereas, feed cost per one kg live weight gain was significantly lower ($P<0.05$) for the two *Spirulina* rations than that of the control one. As well as, total revenue of body weight gain and net revenue as well as economic efficiency were significantly higher ($P<0.05$) for calves fed *Spirulina* rations than those of control ration.

Keywords: Friesian calves, *Spirulina*, rumen activity, plasma biochemical, feed conversion, economic efficiency

INTRODUCTION

The need for improving productive performance of ruminant animals is expanding, particularly in developing countries, so researchers are tested to satisfy the need of individuals with restricted feed assets. Numerous chemical feed additives have been utilized to improve animal efficiency, yet their downsides have the rest of the impact and well being dangers. Therefore, it was important to scan for regular and natural dietary enhancements. Microalgae produce different compounds like sugars, proteins (20-40%), carotenoids (0.3-4 %) and lipids (1-15%). Also, certain microalgae such as *Spirulina*, *Chlorella*, and *Dunaliella* are potentially existent in the feed and food sectors and they can be utilized in numerous business sectors as animal feed additives (Molino *et al.*, 2018). Adding microalgae to animal feed lead to cause oxidative stress in milk, improve superoxide dismutase, glutathione transferase and glutathione reductase activities in the plasma (Mavrommatis *et al.*, 2018). *Spirulina* alage (*Arthrospira*) is a filamentous spiral-shaped belongs to the class of Cyanophyta and potentially considering as sources of protein (65% to 70% dry matter), vitamins, mineral, carotene and xanthophyll (Farag *et al.*, 2016) and as well as having high contents of γ-linoleic acid, phycocyanins, phenolic acids, β-carotene and chlorophyll (Mariey *et al.*, 2012). In spite of being a higher generation cost than basic animals feeding, *Spirulina* speaks to a fascinating elective gratitude to its capacity to develop under alkaline and saline conditions that are inadmissible for most conventional yields (Sassano *et al.*, 2004). The addition of *Spirulina platensis* in animal diets could be improves normal day by day gain and diminishes the feed change proportion (Madeira *et al.*, 2017). *Spirulina* has antioxidant properties, hypolipidemic action and immunostimulating or anti- inflammatory effects (Bashandy *et al.*, 2011). Supplementation of the broiler feed with *Spirulina platensis* diminished centralization of stress hormone and some serum lipid parameters, while improved humoral insusceptibility reaction, raised the cell reinforcement status and feed change proportion (Mirzaie1 *et al.*, 2018). Moreover, the high metabolic rate is joined by an expanded generation of free radicals, and any irregularity between the creation of these atoms and their protected transfer may come full circle in oxidative stress, which can harm cells and tissues (Miller *et al.*, 1993; Lykkesfeldt and Svendsen, 2007). In this manner, under oxidative stress conditions, there is an expanded interest for antioxidants prevention agents to decrease the pernicious impacts of free radicals on the immune system (Carroll and Forsberg, 2007).

It is interesting that natural antioxidants are beneficial to animal and human safety compared with synthetical antioxidants (Makkar *et al.*, 2007;Call *et al.*, 2008). Antioxidants produced by *Spirulina platensis* are known to improve human and animal immunity without side effects and are inexpensive than origeneted synthetically (Khan *et al.*, 2005;Abdel-Daim *et al.*, 2013). As of late, the effect of *Spirulina* additive on animal health and profitability has been reported (Holman and Malaya-Aduli, 2012). In any case, studies on the utilization of *Spirulina platensis* as a feed additive substance in ruminant animals are still very constrained. The capacity of ruminants to process natural microalgal material makes them particularly suited to dietary *Spirulina* use. This is additionally supplemented by a productive assimilation of Spirulina's carbohydrate portion by ruminants once utilised at levels up to 20% of all out feed consumption contrasted and different microalgale feed varieties like alga or Scenedesmus obliquus (Gouveia *et al.*, 2008). additionally,approximately 20% of dietary Spirulina by passes first stomach degradation and is so out there for direct absorption at intervals the fourth stomach (Quigley and Poppi, 2009; Panjaitan *et al.*, 2010; Zhang *et al.*, 2010).This study shows the positive effect of adding *Spirulina platensis* microalga to animal feed as nonconventional, available, cheap and rich in bioactive compounds.

The objective of this study was to invistigate the effect of *Spirulina platensis* algae supplementation in diets of Friesian calves on digestibility, feed intake, rumen ferementation activity, blood metabolities, growth performance and feed conversion as well as economic efficiency.

MATERIALS AND METHODS

Work was carried out at Sakha Animal Production Research Station, Animal Production Research Institute (APRI), Agricultural Research Center, Ministry of Agriculture during the period from June to October 2018.

***Spirulina* cultivation:**

Spirulina platensis microalga was cultivated in true bacteria workplace., biology Dept., Sakha Agricultural analysis Station, Soils, Water, and setting analysis Institute, Kafr El-Sheikh, Egypt. Spirulina was developed during a Zarrouk,s medium (Zarrouk, 1966). once twenty one days incubaction amount, the culture was filtered through sterile material and rinsed well with water to get rid of the residual substraces. The cells were dry at temperature for twenty-four h so continuing in Associate in Nursing kitchen appliance at seventy °C till to succeed in the fastened weight (Fadl *et al*., 2017).

Experimental animals and rations:

Eighteen Friesian calves aged 12 months with initial live body weight of 219.06±5.35 kg were assenged to three similar groups (6 in each). Animals were individually fed a basal ration composed of 50% concentrate feed mixture (CFM) + 30% corn silage (CS) + 20% rice straw (RS) on a DM basis without feed additives (control, R1) or with 1 or 2 g dry *Spirulina*/ head/ day as tested rations R2 and R3, respectively. The corn silage and rice straw were brought from the local area, while concentrate feed mixture was obtained from El-Salam Factory, El-Marg, Cairo, Egypt.

Management:

The experimental calves were weighed in the morning before feeding and drinking water at the beginning of the trial and biweekly thereafter. Calves were individually fed their recommended requirements according to the (NRC, 1996) allowances for growing calves. Rations were adjusted every two weeks according to body weight changes. The CFM was offered two times daily at 8 a.m. and 4 p.m., CS once daily at 11 a.m. and RS was given two times at 9 a.m. and 5 p.m. Dry *Spirulina* was supplemented to CFM in morning feeding. Calves were drinking water three times a day at 7 a.m.,1 p.m. and 7 p.m. and kept under the routine veterinary care through the whole feeding trial. Chemical composition of ingredients and basal ration are presented in Table (1).

Table 1. Composition of ingredients and basal ration.

Item	CFM	CS	RS	Basal ration
DM, %	90.34	27.32	90.15	71.40
Composition of DM, %				
OM	91.15	93.76	83.64	90.43
CP	16.15	8.24	2.56	11.06
CF	9.26	24.62	36.94	19.40
EE	2.98	2.67	1.46	2.58
NFE	62.76	58.23	42.68	57.39
Ash	8.85	6.24	16.36	9.57

Digestibility trials:

Three digestibile trials were conducted during the feeding trial using three calves from each group to determine nutrient digestibility and feeding values. Nutrient digestibility were determined using acid insoluble ash (AIA) method (Van Keulen and Young, 1977). Feces samples were taken from the rectum of each calf twice daily with 12 h intervals for 7 days collection period. Samples of feed ingredients were taken at the beginning, middle and end of collection period. Representative samples of feed ingredients(and feces were analyzed according to (AOAC, 2000).

Rumen liquor samples:

Samples of rumen liquor were collected from calves using a stomach tube at 3 hours after the morning feeding and filtered through double layers of cheesecloth. Value of pH was determined directly in rumen liquor using Orian 680 digital pH meter. Total VFA's concentration was determined by the steam distillation method using Markham micro-distillation unit (Warner,1964). Ammonia nitrogen concentration was determined using a saturated solution of magnesium oxide distillation according to the method of AOAC (2000).

Blood samples:

Samples of blood were withdrawn from the jugular vein of calves using a sterile needle into clean dry heparinzed tubes and centrifuged at 4000 r.p.m. for 15 minutes. Blood plasma constituents (total protein, albumin, urea-N, creatinine, AST and ALT) were calorimetrically determined using commercial diagnostic kits (Test-combination, Pasteur lap.).

Feed conversion:

Feed conversion expreseed as the amounts of feed (kg) DM, TDN and DCP consumed per kg live body weight gain.

Economic efficiency:

Economic efficiency was expressed as a proportion of return to feeding cost based on 2018 market prices. The price of one ton was 5000 LE for CFM, 700 LE for CS and 425 LE for RS, while 500 LE for one kg dry *Spirulina* and 55 LE for 1 kg body weight gain.

Statistical analysis:

Data were statistically analyzed with one-way ANOVA, using the general linear model procedure adapted by IBM SPSS Statistics(2014). Differences among means were tested according to Duncan(1955), whenever the differences were significant.

RESULTS AND DISCUSSION

Nutrients digestibility and feeding values:

Nutrients digestibility coefficients and feeding values of ethe xperimental rations as plagued by Spirulina square measure bestowed in Table (2). Spirulina addition by each levels into the diets of growing Holstein-Friesian calves LED to vital ($P<0.05$) increase in digestion coefficients of all nutrients moreover as TDN and DCP values compared with management diet. Calves supplemented with a pair of g dry Spirulina (R3) recorded considerably ($P<0.05$) the best digestibleness coefficients and feeding values followed by one g dry Spirulina (R2), while the control control teams gave very cheap values.These positive effects of Spirulina addition on digestibleness and feeding prices of the Spirulina rations greatly because of the broad spectrum of extremely biologicaly value compounds that inrolved in Spirulina alage. because of the very fact that Spirulina alage probably contains a heap of biologically active substances, it's been utilized in animal nutrition for all placental categories (Colla *et al*., 2008; Carrillo *et al*., 2008; Kuplys *et al*., 2009). Earlier studies unconcealed that concerning 20% of dietary Spirulina bypasses degradation in tum and thus offered for direct absorption at intervals the breadbasket (Quigley and Poppi, 2009; Panjaitan *et al*., 2010; Zhang *et al*., 2010). Distinctly, results here square measure in agreement with those obtained by Hassan *et al.* (2015) who used *Spirulina* alage in the rations of dairy goats.

Table 2. Nutrient digestibility and feeding values of experimental rations.

Item	R1	R2	R3	SEM
		Digestibility, %		
DM	65.38[c]	67.48[b]	68.80[a]	0.37
OM	66.69[c]	68.83[b]	70.17[a]	0.41
CP	64.73[c]	66.80[b]	68.11[a]	0.35
CF	63.75[c]	65.79[b]	67.08[a]	0.32
EE	68.65[c]	70.85[b]	72.24[a]	0.39
NFE	67.34[c]	69.50[b]	70.86[a]	0.38
		Feeding values, %		
TDN	62.16[c]	64.15[b]	65.41[a]	0.35
DCP	7.16[c]	7.39[b]	7.53[a]	0.04

a, b, c: Values in the same row with different superscripts differ significantly (P<0.05).

Feed intake:

The effect of *Spirulina* additive on Feed consumption by Friesian calves is shown in Table (3). The intake of CFM, CS and RS expressed as fed basis as well as total DM, TDN, and DCP intakes were slightly increased with tested rations compared with the control one. These results indicated that *Spirulina* additive for growing calves doesn't have a significant effect on feed intake. The obtained Results are consistent with results obtained by Hafez *et al*. (2013) who found that *Spirulina* supplementation for growing lambs slightly improved feed intake compared with the control (P<0.05).

Table 3. Feed intake of calves fed the experimental rations.

Item	R1	R2	R3	SEM
		As fed basis (kg/head/day)		
CFM	4.88	4.93	4.94	
CS	9.69	9.77	9.80	
RS	1.96	1.97	1.98	
Total intake	16.53	16.68	16.72	
		As DM basis (kg/head/day)		
Total DM	8.82	8.90	8.93	0.20
TDN	5.47	5.71	5.84	0.14
DCP	0.63	0.66	0.67	0.02

Rumen fermentation activity:

Rumen liquor parameters presented in Table (4) seemed to be significantly (P<0.05) affected by *Spirulina* alage addition into the diets of calves. Total VFA's concentration was higher significantly (P<0.05), while pH values and concentrations of NH_3-N were lower significantly (P<0.05) in rumen liquor with both levels of *Spirulina* additive compared with those of control that free from such additive. Also, the high level *Spirulina* ration had significant better effects on rumen function parameters than those of the low one. Moreover, this results ar harmonious with those according by Choi *et al*. (2012) who found that over bodily cavity microorganism population, desired lactobacillus spp was linearly increased in pigs supplemented with enhance E. cava alage levels in diets, while the population of undesired E. Coli were linearly reduced (P<0.05), and also the population of clostridum spp tended to decrease with the alage supplemented pigs. The same authers concluded that Ecklonia cava alage had helpful effects on the expansion performance, bodily cavity microflora and enteric morphology (villus hight) of wealing pigs. Spirulina has been appeared to expand crude protein production and to decrease its maintenance time inside the rumen (Quigley and Poppi, 2009). Rumen fermentation activity improved with Spirulina additive for cows (Zhang, 2011). Gaafar *et al*. (2018) found that ruminal TVFA's concentration increased significantly (P<0.05), however, ruminal NH3-N concentration decreased significantly (P<0.05) with the two levels of Spirulina.

Table 4. Rumen fermentation activities of calves fed the experimental rations.

Item	R1	R2	R3	SEM
pH	6.32[a]	6.18[b]	6.02[c]	0.02
TVFA's (meq/ 100 ml)	12.63[c]	15.61[b]	17.37[a]	0.51
NH_3-N (mg/ 100 ml)	13.00[a]	11.28[b]	10.27[c]	0.29

a, b, c: Values in the same row with different superscripts differ significantly (P<0.05).

Blood biochemical:

Blood biochemical parameters in plasma of Friesian calves are presented in Table (5). Only, the concentration of total protein increased significantly (P<0.05) with the two levels of additive compared that of control one. Whereas, the concentrations of albumin, globulin, urea nitrogen, and creatinine as well as the liver enzyme activity (AST and ALT) didn't significantly (P<0.05) affected by dietary treatments of the experiment. Increase the total protein Of plasma may be It is why to high protein content in Spirulina alage (Gershwin and Pillay,2008). Current results are consistent with the findings that recognized by Hassanien *et al*. (2015) who worked with goats and used *Spirulina* alage at 0.2% of their feed intake. Likewise, Hafize *et al.* (2013) found that blood total protein and albumin concentrations were significant higher with 0.2% *Spirulina platens* alage of DMI of growing lambs than those of control diet that free from alage supplement. In additions, the rest of blood parameters (globulin, cholesterol, triglycerides, creatinine, urea-N, AST and ALT) cpncentrations did not significantly affected by dietary alage supplements. Moreover, similar results were observed Khalifa *et al*. (2016) with dairy goats, in which *Spirulina* alage addition at 500 mg/head/day had significant increased total protein and glucose concentrations, reduced significantly each of cholostrol, triglycerids, AST and ALT, while did not affect on urea contents, compared with the control diet that free from *Spirulina* supplement. Gaafar *et al.* (2018) reported that most blood biochemical parameters were markedly increased with increasing the *Spirulina* level in drinking water of cows.

Table 5. Blood plasma biochemical parameters of calves fed the experimental rations.

Item	R1	R2	R3	SEM
Total protein (g/100 ml)	9.73[b]	10.23[a]	10.38[a]	0.12
Albumin (g/100 ml)	3.77	3.82	3.96	0.07
Globulin (g/100 ml)	5.96	6.42	6.43	0.14
Urea-N (mg/100 ml)	46.37	48.99	46.87	4.53
Creatinine (mg/100 ml)	0.96	1.05	1.04	0.05
AST (U/L)	59.22	56.45	57.52	3.08
ALT (U/L)	35.33	35.00	34.17	1.54

a, b: Values in the same row with different superscripts differ significantly (P<0.05).

Live body weight and body weight gain:

Live body weight and body weight gain of calves as affected by *Spirulina* additive are shown in Table (6). Initial live body of calves in the different groups was nearly similar at the beginning of the experiment. Whereas, final body weight, total and daily weight gain, as well as the improvement of ADG were significantly higher (P<0.05) for calves diets supplemented with either 1 or 2 g *Spirulina* than those of control one. Also, the 2 g *Spirulina* ration had significant higher values of the mentioned traits than those of 1 g *Spirulina* ration. These results might be attributed to the improvements in nutrients digestibility and nutritive values (Table 2) and the positive rumen fermentation activities (Table 4). Current results are consistent with Bezerra *et al.* (2010) who found that lambs receiving *Spirulina* had higher live weights and daily gains compared with those of untreated one (control). Findings recorded by Holman *et al*. (2012) also show an increase in lamb live weights with dietary *Spirulina* along with an increase in body condition score and other body adaptation attributes. EL Sabagh *et al.* (2014) found that *Spirulina* supplementation for growing rabbit diets improved final live body weight and daily live weight gain compared with the control (P<0.05).

Furthermore, significant positive effects on kids performance (Weight of birth, weight after weaning, total gain and daily gain)due to addition of *Spirulina* alage into the diet of their dam were found by Hassanien *et al.* (2015).

They also proved that milk yield and its composition of dairy goats were significant increased with *Spirulina* supplement compared with zero supplmental ration. Similar results have been recorded by Khalifa *et al*. (2016) who demonstrated that milk yield during sackling period was significant higher with supplemented diet of goats with *Spirulina platens* powder than that of diet without supplement. of HeMl (2002) reported a 10% increase in body weight gain the pigs supplemented with alage. Obviously, the development in nutrients edibility and growth performance may be the results of the decrease of harmful bacterium like E. coli and also the increase of frienadly bacterium like eubacterium in weanling pigs microbiota.

Lactobacilli ar ready to turn out sugar depolymerases and glycosidases which may improve the edibility of nutrients by degrading the structural sugar in plant semipermeable membrane (Macfarlane *et al*., 1990).

Lastely, Hafez *et al.* (2013) found vital will increase in daily gain with growing lambs that fed diets supplemented with either Spirulina alage or commer-cial preparation of seaweeds, by 19% and13%, severally, supported management diet that free from any supplements.

Table 6. Live body weight and body weight gain of calves fed the experimental rations.

Item	R1	R2	R3	SEM
Initial body weight (kg)	218.00	220.00	219.17	5.35
Final body weight (kg)	316.67c	340.00b	347.50a	9.12
Total weight gain (kg)	98.67c	120.00b	128.33a	7.09
Daily gain (kg)	0.70c	0.86b	0.92a	0.05
Improvement %	-	22.86	31.43	0.78

a, b, c: Values in the same row with different superscripts differ significantly (P<0.05).

Feed conversion:

Results in Table (7) showed that feed conversion of calves improved significantly (P<0.05) with *Spirulina* additive. The amounts of DM, TDN and DCP needed per one weight unit weight gain were lower considerably (P<0.05) for calves in R2 and R3 supplemented with dry *Spirulina* compared with those of control one. Feed conversion of DM, TDN and DCP were nearly similar for the two levels of *Spirulina* supplementation without significant differences between them. These results agreement with those obtained by EL Sabagh *et al.* (2014); Madeira *et al.* (2017) and Mirzaie1 *et al.* (2018) who found that *Spirulina* supplementation improved feed conversion ratio compared with the control (P<0.05). Gaafar *et al.* (2018) reported that *Spirulina* leds to a significant decrease (P<0.05) in the amounts of DM, TDN, CP and DCP/ 1 kg 4% fat-corrected milk (FCM).

Table 7. Feed conversion and economic efficiency of calves fed the experimental rations.

Item	R1	R2	R3	SEM
Feed conversion				
DM (kg/kg gain)	13.22a	10.43b	10.41b	0.64
TDN (kg/kg gain)	8.19a	6.70b	6.81b	0.38
DCP (kg/kg gain)	0.94a	0.77b	0.78b	0.04
Economic efficiency				
Feed cost (LE/day)	32.50	32.82	33.40	0.78
Feed cost (LE/kg gain)	44.82a	37.87b	37.78b	2.00
Total revenue (LE/day)	41.41b	47.14a	50.42a	2.68
Net revenue (LE/day)	8.91b	14.33a	17.02a	2.37
Economic efficiency	1.27b	1.44a	1.51a	0.07

a, b, c: Values in the same row with different superscripts differ significantly (P<0.05).

Economic efficiency:

Economic efficiency in Table (7) revealed that the daily feed cost was nearly similar for the different groups without significant difference among them. Whereas, feed cost / kg live weight gain was significantly higher (P<0.05) for control compared with the groups supplemented with *Spirulina* alage. As well as the total revenue of body weight gain and net revenue as well as economic efficiency were significantly higher (P<0.05) for calves in supplemented rations (R2) and (R3) than those of control one. Data on economic efficiency were nearly similar between the two levels of *Spirulina* additive without significant differences among them. These results agree with those obtained by Gaafar *et al*. (2018) who showed that *Spirulina* additive resulted in significant (P<0.05) improvements in economic efficiency. Total revenue of milk yield increased significantly (P<0.05) and feed cost per 1 kg 4% FCM was decreased significantly (P<0.05) with *Spirulina* ration compared with those of the control one. Similar results were recorded by Hafez *et al*. (2013) who found markedly positive effect on economical efficiency due to *Spirulina* alage supplementation into the the rations of growing lambs. Moreover, with dairy goats Khalifa *et al*. (2016) revealed that a marked improvement in economic efficiency when added 500 mg of *Spirulina* powder into the control diet (100.00 vs. 127.27%).

CONCLUSION

In conclusion, *Spirulina* alage supplementing to the diet of calves at the levels of 1 and 2 g *Spirulina* /day had the better results for nutrient digestibility, feed intake, rumen fermentation activity, blood biochemical parameters, body weight gain, feed conversion ratio, and economic efficiency.

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تأثيراضافة طحلب اسبيرولينا بلاتينسيس على أداء عجول الفريزيان النامية

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أجريت هذه الدراسة لتقييم تأثيراضافة طحلب اسبرولينا بلاتينسيس الجاف للعجول الفريزيان النامية على نشاط تخمرات الكرش، الهضم، أداء النمو، الكفاءة الاقتصادية. استخدم فى هذه الدراسة عدد ١٨ عجل فريزيان متوسط الوزن ٢١٩.٠٦ ± ٥.٣٥ كجم عمر ١٢ شهر واستمرت التجربة لمدة ١٥٠ يوم وقسمت الى ثلاثة مجموعات متماثلة. تم تغذية الحيوانات بشكل فردي علي العليقة الأساسية وتتكون من ٥٠% مخلوط علف مركّز + ٣٠٪ سيلاج ذرة + ٢٠٪ قش أرز على أساس المادة الجافة بدون إضافات (كنترول، ج١) أو مع اضافة ١ أو ٢ جم سبيرولينا جافة / راس / يوم للمجموعتين ج٢، ج٣ على التوالى. أظهرت النتائج أن ج٣ حققت زيادة معنويه في جميع معاملات الهضم والقيم الغذائية بالمقارنة بالمجموعتين ج٢، ج١. كانت الكميات المأكولة من المادة الجافة والمركبات الكلية المهضومة والبروتين الخام المهضوم متماثلة تقريبا للمجموعات الثلاثة. زيادة تركيز الاحماض الدهنية الطيارة فى سائل الكرش معنويا، بينما انخفضت قيمة درجة الحموضة وتركيز نيتروجين الامونيا معنويا مع العلائق المضاف اليها اسبيروليناً مقارنة بعليقة الكنترول. كذلك زاد تركيز البروتينات الكلية في البلازما معنويا مع اضافة الاسبيرولينا مقارنة بالكنترول. كما اظهرت زيادة معنوية في الوزن فى نهاية التجربة والزيادة الكلية فى الوزن ومعدل النمو اليومي وكذلك التحسن فى معدل النمو اليومى مع المستوى المرتفع للاسبرولينا مقارنة بالمستوى المنخفض للاسبيرولينا ومجموعة الكنترول. تحسن معدل التحويل الغذائى حيث انخفضت كميات المادة الجافة والمركبات الكلية المهضومة والبروتين الخام المهضوم اللازمة لكل كيلو جرام نمو معنويا للعجول المغذاة علي علائق الاسبرولينا مقارنة بمجموعة الكنترول. تماثل متوسط تكلفة التغذية اليومية تقريبًا للمجموعات المختلفة. بينما انخفضت تكلفة التغذيه لكل كيلو جرام نمو لمجموعتى علائق الاسبيرولينا مقارنة بمجموعة الكنترول. وكذلك ارتفاع العائد الكلي والعائد الصافى والكفاءة الاقتصادية للعجول المغذاة على علائق الاسبيرولينا عنه فى مجموعة الكنترول. من هذه الدراسة نستخلص أن اضافة الاسبرولينا إلى العجول الفريزيان النامية بمستوي ١ و ٢ جم سبيرولينا / رأس/ يوم حقق أفضل النتائج من حيث هضم العناصر الغذائية، الغذاء الماكول، نشاط تخمرات الكرش، بعض قياسات الدم البيوكيميائية، معدل النمو، معدل التحويل الغذائى، الكفاءة الاقتصادية.