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THE MILK INDEX, BLOOD BIOCHEMISTRY STATUS AND GROWTH PERFORMANCE OF LOCAL MALAYSIAN COW (*Bos sundoicus*) FED *Arthrospira platensis* SUPPLEMENT

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ABSTRACT

An experimental feed trial was carried out for 40 days to assess and investigate the bio-physiological effect of locally isolated indigenous *Arthrospira platensis* on the growth performance, milk quality index of the local female Kelantan cattle bred type trait (*Bos sundoicus*). Sixteen healthy local Kelantan cows (68.6±8.12 kg, 1.21±0.26 years old) were randomly allotted into four groups, viz. one group fed standard diet and three groups with formulated diets with variable strength of *A. platensis* supplement. There were significant body weight increments and milk volume as shown by the treated cows ($p<0.05$) when fed with 2-6g/10kg body weight/d; the milk quality and nutrient composition have demonstrated notable changes. The milk volume of cows treated with *A. platensis* increased by more than 15% and the milk protein recorded was higher by more than 9% on day 15 when supplemented with Spirulina. However, the sugar content in the treated cows decreased by 13%. Meanwhile, supplementation in cows had elevated the high density lipoprotein (HDL) levels by 12 – 19% ($p<0.05$) and lowered the total cholesterol (TC) by 12 – 18% on day 30. The liver-kidney markers and related biochemical enzyme indicators in the treated and untreated cows, such as blood urine nitrogen (BUN), creatinine (Cr), urea, uric acid and alanine aminotransferase (ALT) remained stable all the way throughout the experimental period. The aspartate aminotransferase (AST) levels in the treated cows reduced significantly. However, these levels were still within the normal acceptant range of the cattle during the study period.

Key words: Cow, *Arthrospira* sp., milk index, blood chemistry, performance

INTRODUCTION

In general, the local cows of the Kelantan cattle species (*Bos sundoicus*) type originated from the Malaysian peninsular and Indonesia, are actual grazers rather than browsers like goats, preferring to use a wide area of grass pasture (Md Yusuff Sudin, 2010). The local cattle belongs to the race or sub-group *Bos indicus* whose origin was from Asia and Africa. The other related cattle race is *Bos tourus* whose origin was from Europe (Herring, 2014). The different types of tropical grass grazed by the cattle comprised of *Brachiaria humidicola,* napier *Pennisctum purpureum* (locally known as rumput gajah) and *Pennisctum purpureophoides* are some of the common greens grazed by the cattle ruminants. The grass has the capability to alter or change fibrous feed into different type of nutrients needed by the animals with the help of micro-flora organism in the rumen (Md Yusuff Sudin, 2010). The source of energy is from the feed material which is composed of 20% crude protein, 18% crude fibre and 35% cellulose plant cells (Simcus *et al*., 2007).

Protein is a fundamental element in the animal feed. Traditional farmers are more likely feeding their livestock with low protein source from locally grown plants and crops. Soybean meal, fishmeal, sunflower meal, cottonseed cake and groundnut cake are among available alternative high protein resources, even though they are seasonal and expensive due to their high demand by nutritionists and feed industries (Herring, 2014). It is desirable

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to identify suitable alternative replacement that demands high nutritive value, conversion efficiency and yet cost-effective such as the microalga, *Arthrospira platensis.*

In regards of the use of *A. platensis* on livestock, there seem to be a limited assessment and feeding trials being carried out on its biochemical composition and nutritional benefits. Among those trials are on rats (Nagaoka *et al*., 2005), rabbits, calves (Herdarpour *et al*., 2011), fishes (Rodehutscord *et al*., 1997), shrimp, lambs (El-Sabagh *et al*., 2014), sheep (Holman *et al*., 2004) and primate (Yin *et al*., 2004). Among the beneficial effects of *A. platensis* are as antioxidant (El-Sabagh *et al*., 2014), anti-inflammatory and anti-pyretic (Muhammad Nazrul *et al*., 2014), anti-cholesterol (El-Sabagh *et al*., 2014), anti-bacterial (Ozdemir *et al*., 2004) and also anti-cancer (Kunickuva *et al*., 2014) agent. All these advantages and benefits bring about better health, growth and reproductive performances to the animals.

The worldwide changes in consumer taste and growing business sector are the two main reasons that caused the stipulation for livestock products (especially meat, egg, and milk) to keep on increasing. In actuality, these livestock products could provide more than 33% of the protein used in human diets and about 10% of the food energy (FAO, 2003). It should be noted, the major profitability of dairy farming depends on the livestock productivity which in turn very much related to the livestock feed quality. The overall effectiveness of *A. platensis* based nutrient supplement is also related to the physiological bodily conditions of the livestock in terms of their age, maturation, growth stage, developmental physiological stage and lactation period (Kulpys *et al*., 2009).

As for the genetically modified (GM) crop diet in livestock feed, it is just like anything other than as safe as those from livestock fed convectional crops, such as napier (Aumaitre *et al*., 2002). The feed for the ruminant brought wide range of benefits to the livestock with respect to their growth and health performance such as body weight changes (Shimkiene *et al*., 2010), productivity (Simkus *et al*., 2007) and product quality (Christaki *et al*., 2004). A feeding trial on ruminant local cows utilizing indigenous *A. platensis* was conducted to analyse growth performance, milk quality, serum cholesterol levels, kidney-liver health and performance status.

MATERIALS AND METHODS

The indigenous local Malaysian strain of the filamentous cyanobaterium or micro-alga, *A. platensis* is isolated from the pristine alkaline tropical lake, Tasik Dayang Bunting, Langkawi, Kedah, Malaysia; this micro-alga was molecularly tagged for identification purposes and subsequently was grown in modified Zarrouk medium (Zarrouk, 1966) at an ambient temperature of 30±2°C, alkaline pH (8.5 to 9.0) and under cool white fluorescent source (30 µmol photon $m^{-2}s^{-3}$). The cyanobacterium was then mass cultured in the 300-L Plug Flow Reactor, filtered, dried and finally powered as supplement feed for the cattle. The micro-alga can be dried in the form of dried flake mass (Figure 1).

Research animal and experimental set-up.

Sixteen healthy local cow (68.6±8.12 kg, 1.21±0.26 years old) were housed in a clean & well ventilated pens located in the local Bachok cattle farm establishment. The cattle farm management is directly managed by the local district authority and the Kelantan Veterinary Services Department. The cows were divided into 4 groups; cows fed standard diet and treated diets comprised of AP (treated with 2 g/10kg body weight/d), 2AP (treated with 4 g/10 kg body weight/d) and 3AP (treated with 6 g/10 kg body weight/d) (Table 1). *Arthrospira platensis* was harvested and given to cows daily via force-feeding using oral gavage. The nutrient composition, including protein, carbohydrate, fibre and lipid of the group diet standard (SM) diet and treated groups (AP, 2AP and 3AP) was analysed accordingly by method of AOAC (1997).

Laboratory set-up and biochemical patho-physiological tests

Milk was collected from the weighed cows once daily and further quantified for its sugars, protein, calcium and phosphorus content using the method described by AOAC (1997). For the blood analysis, 3 ml blood was withdrawn via jugular vein using a needle with the size of 18 G. The blood samples were centrifuged at 5000 rpm for 10 min before being subjected onto automatic analyzer Roche Coba Mira (Thermo Fisher Scientific,USA) and Hitachi 902 Machine for serum cholesterol and

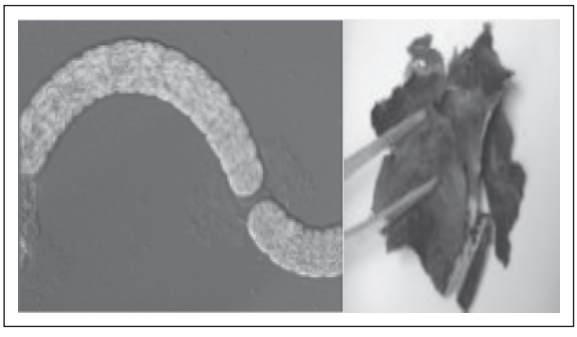

Fig. 1. Confocal Microscopy of i) *Arthrospira platensis*; ii) *Arthrospira platensis* in the form of dried flake mass from left to right.

kidney-liver analysis. The analysis includes total cholesterol (TC), low density lipoprotein (LDL), triglyceride (TG), high density lipoprotein (HDL, aspartate transaminase (AST), alanine transaminase (ALT), gamma glutamyl transferase (GGT), creatinine (Cr) and blood urea nitrogen (BUN). All blood samples were collected at day 0 (pre-treatment), 30 and 60 (post-treatment).

Statistical analysis

The milk and blood results were determined for statistical significance (p=0.05) using one-way ANOVA by SPSS statistical software (SPSS 16.0 for windows) and Tukey's test was used for pairwise comparison of the mean values.

Ethical guideline

The ethical guidelines on handling the experimental animals were in observance with the standard operational procedure of animal ethics which were verified by the committee of the Faculty of Veterinary Medicine (REF: DVM2016/UMK/D11A027FYP), Universiti Malaysia Kelantan and the Kelantan Veterinary Services Department.

RESULTS AND DISCUSSION

Growth production in female Kelantan bred cattle

Feed is the major limiting factor in the local cattle production, more so in the dry and humid tropical region. It is important to provide the local cattle with available indigenous source comprising of food forage, legumes, minerals and concentrate (NIIR, 2004). Research findings involving the *Arthrospira* sp and cattle are scare and restricted. Comparisons were made by comparing the data with other ruminants. Generally, the feed components, such as proteins, carbohydrates and fats are contributors for the body weight gain in livestock and human. Fats are believed to have more fattening extent than proteins and carbohydrates (Swinburn *et al*., 2004) owing to lower thermic effect (Schwartz *et al*., 1992). Proteins and carbohydrates deposited 4 calories per gram while approximately 9 calories per gram by fats. Table 1 shows the significant increase ($p<0.05$) in the crude protein composition of the treated cow diets with values of 1-2 times as compared to that of the standard diet; however the other components viz. crude carbohydrate, crude lipid and crude fibre remain the same. There was also a significant ($p<0.05$) increase in the cow body weight treated with the alga supplement in the treated groups with growth body weight increment values of 29, 24 and 22% for the AP, 2AP and 3AP diet groups respectively (Table 2).

It is interesting to note that the outcomes of the experiment were in accordance with other studies by Kulpys *et al*. (2009), El-Sabagh *et al*. (2014) and Kashani *et al*. (2015). Kulpys *et al*. (2009) discovered that by giving diurnal administration of 200 g of *A. platensis* to dairy cows resulted in fattening the animal by 8.5–11%. Similar effects were observed when sheep and calves were given *A. platensis* supplementation (Heidarpour *et al*., 2004). These results (Table 2) were in agreement with the finding stated that cyanobacterium supplementation emphatically up-regulated the

Table 1. The proximate composition of the cow experimental diets

Composition (%)	SM	AP	2AP	3AP
Crude carbs	9.93±0.71^{a}	9.89±1.24^{ab}	9.93±1.86^{c}	9.91±0.94^{c}
Crude protein	7.90±0.81^{a}	15.7±0.78^{b}	19.2±0.61^{c}	24.3±2.71^{d}
Crude lipid	4.91±0.41^{a}	5.14±0.52^{ab}	5.69±0.38^{c}	5.61±0.91^{c}
Crude fibre	16.1±1.94^{a}	15.9±1.14^{ab}	16.8±1.33^{c}	16.9±1.76^{c}

SM standard diet group; AP single amount supplement (2 g/10kg BW/d) diet group; 2AP twice amount supplement (3 g/10kg BW/d) diet group; 3AP trice amount supplement (4 g/10kg BW/d) diet group; Values (mean±SE) with different superscripts in the same row are significantly different at the 5% level, N=4; BW body weight; carbs is carbohydrate.

Table 2. Initial and final cow body weight (kg) during experimental period

	SM	AP	2AP	3AP
Final Weight	84.1±9.21^{a}	79.1±8.71^{b}	89.2±9.96^{c}	84.2±8.11^{d}
Initial Weight	69.2±6.82^{a}	56.3±5.19^{b}	67.3±6.21^{c}	65.1±5.94^{d}

SM standard diet group; AP single amount supplement (2 g/10kg BW/d) diet group; 2AP twice amount supplement (3 g/10kg BW/d) diet group; 3AP trice amount supplement (4 g/10kg BW/d) diet group; Values (mean±SE) with different superscripts in the same row are significantly different at the 5% level, N =4; BW body weight.

two genes (ADRB3 and FASN) which regulate fat production (Kashani *et al*., 2015). El-Sabagh *et al*. (2014) showed better weight gained of 17% body weight increase after feeding the lambs 1g/10 kg/d with the algal concentrate. However, it is vital to mention here that feeding ruminant particularly sheep and lambs with too high doses of the alga could lead to a deficit in intra-muscular fat content due to increased melatonin production in muscle tissues and also up-regulation of mRNA expression which later will impair fat depletion (Kashani *et al*., 2015). In most ruminants, 20% of dietary *Arthrospira* sp. could directly be absorbed in abomasum after bypassing the rumen (Panjaitan *et al.,* 2010; Zhang *et al.,* 2010). However, the growth productivity of livestock is also associated with the ruminant bacterial community which strongly depends on the diet effectiveness (Belanche *et al*., 2012). This illustrates how the communal micro-organisms of the ruminant host (microbiota) and their genomes (microbione) contribute a functional responsibility in livestock digestion, health status and immune system (Backhed *et al*., 2005). In facts, these gut microorganism have been assigned to act as like microbial organs with regard to their metabolic activities to process plant materials which are absent in the ruminant digestive systems (Yoon *et al*., 2015). This microorganism will eventually radiate and distribute the extracellular enzymes resulting in inducing the livestock growth (Gershwin & Belay, 2008).

Milk indicator and indices

Milk production of the treated experimental cow has been significantly enhanced ($p>0.05$) during the first month trial, especially the AP group with values of 2.87±0.41 litres and 3.21±0.65 litres on day 15 and day 30, respectively (Table 3). About 14% and 29% increases were denoted by AP group on day 15 and day 30 respectively. During the same time, the elevation of nutrient composition in milk especially protein and minerals (Ca, P) was also detected. There was a significant difference ($p>0.05$) shown in protein, Calcium and sugars of the AP group. An increase of 9% was recorded in protein while the sugars decreased by 13%. However, the Ca and P content in the milk of the AP group increases with values of 19% and 54%, respectively (Table 3). Thus, besides other than the milk volume being elevated, the cows have also produced a high protein with low sugars milk. The efficiency of *Arthrospira* sp. in increasing milk production has been shown in cows which correspondently reported elsewhere (Simkus *et al*., 2015).

There are varieties of embedded plant compounds and their metabolites as potential absorbable material in the gastro-intestinal system. Once absorbed into the blood, these elements will be elementary exuded by the mammary gland in the milk. Any toxins ever present in the milk that may cause changes in the taste of milk may be harmful to the consumers (Matthews *et al*., 2009). As for a better quality milk production in ruminants, there

Table 3. Changes of cow volume & its nutrient milk composition before and after feeding experiment

	Day 0	Day 15	Day 30
Volume (L)			
SM	2.21±0.28^{a}	2.19±0.31^{a}	2.20±0.45^{a}
AP	2.51±0.38^{a}	2.87±0.41^{b}	3.21±0.65^{c}
	Nutrient composition per 100 ml		
	Day 0	Day 15	Day 30
SM Group			
Protein (g)	3.18±0.48^{a}	3.19±0.41^{a}	3.17±0.41^{a}
Sugars (g)	0.30±0.08^{a}	0.28±0.04^{a}	0.29±0.05^{b}
Ca (mg)	55.1±7.28^{a}	56.7±6.31^{a}	54.1±6.45^{b}
P(mg)	15.9±1.39^{a}	16.1±1.91^{a}	16.7±1.35^{b}
	Day 0	Day 15	Day 30
AP Group			
Protein (g)	4.11±0.48^{a}	4.48±0.42^{b}	4.52±0.61^{c}
Sugars (g)	0.61±0.09^{a}	0.74±0.08^{b}	0.71±0.08^{c}
Ca (mg)	82.1±9.28^{a}	95.1±9.81^{b}	97.1±6.75^{b}
P(mg)	31.2±4.39^{a}	48.1±6.91^{b}	49.7±4.95^{c}

SM standard diet group; AP single amount supplement (2 g/10kg BW/d) diet group; 2AP twice amount supplement (3 g/10kg BW/d) diet group; 3AP trice amount supplement (4 g/10kg BW/d) diet group; Values (mean±SE) with different superscripts in the same row are significantly different at the 5% level, N=4; BW body weight.

should be plenty of glucose, essential amino acids, free fatty acid together with propionic acid that are actively involved in milk production. In facts, the glucose of energy feed is fermented into volatile fatty acids especially propionic acid and linolenic acid, both of which play a vital role in milk production. However, it is expected that there bound to be scarce amount of glucose bypasses to the mammary gland. In contrast, the building blocks of milk protein especially amino acids are believed to be accessible and easily available in the blood as major precursors during milk synthesis within the mammary gland (National Institute of Industrial Research, 2004). The branched chain amino acids (BCAA) comprised of leucine, valine and isoleucine are engaged in the mammary condition, milk nutrient and embryo growth. The BCAA is also involved in building the muscle tissue as well as assisting the protein synthesis which is responsible for the better growth performance in both livestock and human. As noted, *Arthrospira* sp has up to 70% protein which comprised of the 20 amino acids including BCAA; however, there is 63.7 g/kg valine, 57.5 g/kg isoleucine and 90.7 g/kg leucine in *A. platensis* (Nagaoka *et al*., 2005).

Clinical serum biochemistry of cow

The overall results of serum cholesterol including TC, LDL, TG and HDL in cow are shown in Table 4. Cow fed *A. platensis* (AP, 2AP and 3AP groups) showed a significant deficit ($p<0.5$) in TC level on day 30 of feeding trial with a decrease in TC value of 12%, 18% and 14%, respectively (Table 4). In 2AP group, good cholesterol HDL showed notable raise at a significant level of $p<0.05$ with a value of 19.5% increase on day 30 day. Stable levels of LDL and TG were observed throughout the experimental period for the SM group. There was a slight decrease exhibited in LDL and TG levels for all the treated groups throughout the experimental period.

Al-Bilushi *et al*. (2009) reported that the normal Saanen goat (age 12-23 months) have 71.18±0.41 mg dL^{-1} which is equivalent to 3.95 mmol L^{-1} serum cholesterol; while in other ruminants such as calves, there were reduced values observed in TC and LDL with values of 33% and 25% within 57 days after being supplemented with 25 g/d *A. platensis* of feeding trials (Heidarpour *et al*., 2011). Our experimental result was in agreement with El-Sabagh *et al*. (2009) in which there was notable decrease in TC levels of lambs fed with *A. platensis.*

The nutrition factor and the blood biochemistry status of ruminant have a profound effect on the animal growth and health status. Thus, the finding supported the previous discoveries that *A. platensis* has an anti-hyperlipidemic effect on livestock. Devi and Venjkataranam (1983) had carried out a successful preclinical trial using *A. platensis* as an anti-hyperlipidemic effect on albino rats. It was believed the beneficial anti hyperlipidemic effects of *A. platensis* were due to its bioactive compounds, such as γ-linolenic acid (GLA), phycocyanin and β-carotene. These compounds have been known to support healthy inflammatory response and numerous antioxidant effects; such agents with

Table 4. Values of total cholesterol (TC), low density lipoprotein (LDL), triglyceride (TG) and HDL-cholesterol in the cows on 0, 15, 30 and 40 d of treatment and cow diet groups (SM, AP, 2AP and 3AP)

	Time (d)	SM	AP	2AP	3AP
TC (mmol.L^{-1})	0	83.9±9.98^{a}	89.2±9.31^{a}	87.2±8.45^{a}	88.7±6.41^{a}
	15	83.7±9.31^{a}	85.1±8.71^{ab}	62.0±7.32^{c}	71.5±9.22^{d}
	30	83.7±9.16^{a}	73.1±9.82^{b}	74.1±8.27^{c}	71.7±8.92^{d}
	40	82.9±8.36^{a}	68.7±9.73^{ab}	62.6±7.21^{ac}	67.6±8.29^{ad}
LDL (mmol.L^{-1})	0	1.20±0.13^{ab}	1.06±0.17^{ab}	1.87±0.15^{ab}	1.09±0.21^{a}
	15	1.22±0.21^{ab}	1.04±0.28^{a}	1.82±0.12^{ab}	1.05±0.15^{ab}
	30	1.31±0.17^{ab}	1.05±0.23^{b}	1.81±0.11^{ab}	1.06±0.15^{a}
	40	1.25±0.17^{a}	1.01±0.31^{ab}	1.59±0.21^{ac}	1.01±0.18^{ad}
TG (mmol.L^{-1})	0	0.19±0.02^{ab}	0.31±0.03^{bc}	0.42±0.01^{a}	0.38±0.05^{ab}
	15	0.17±0.07^{a}	0.31±0.06^{b}	0.23±0.02^{a}	0.35±0.02^{ab}
	30	0.18±0.01^{a}	0.29±0.03^{b}	0.31±0.05^{c}	0.39±0.09^{d}
	40	0.16±0.24^{a}	0.21±0.08^{b}	0.31±0.09^{c}	0.36±0.01^{d}
HDL (mmol.L^{-1})	0	1.73±0.23^{a}	2.19±0.27^{a}	2.15±0.32^{a}	2.21±0.26^{a}
	15	1.65±0.31^{a}	2.51±0.21^{ab}	2.81±0.33^{ab}	2.39±0.24^{ab}
	30	1.73±0.27^{a}	2.56±0.27^{b}	2.57±0.21^{cd}	2.49±0.28^{d}
	40	1.61±0.22^{a}	2.75±0.15^{b}	2.65±0.32^{cd}	2.41±0.23^{d}

SM standard diet group; AP single amount supplement (2 g/10kg BW/d) diet group; 2AP twice amount supplement (3 g/10kg BW/d) diet group; 3AP trice amount supplement (4 g/10kg BW/d) diet group; Values (mean±SE) with different superscripts in the same row are significantly different at the 5% level, N=4; BW body weight.

antioxidant and anti-inflammatory activity have the potential to combat cardiovascular diseases (CDVs). The dietary supplement comprising of phycocyanin, carotene, and γ-linolenic acid has proven to be beneficent to inhibit oxidative stress and lipid peroxidation. Numerous studies have identified that phycocyanin could detoxify the free radical components such as alkoxyl, hydroxyl, peroxyl, and superoxides (Romay *et al*., 2003). Thus, this proved that oxidative stress is responsible for the vast majority of the degenerative diseases. β-carotene is as an effective inhibitor for oxidative stress while lipid peroxidation has been proven to be an effective inhibitor for oxidative stress (Allard *et al*., 1994). In addition, Kasperczyk *et al*. (2014) revealed that β-carotene had the ability to improve glutathione as well as altering antioxidant defence system. GLA has been known to have a cholesterol lowering effect; however the exact characteristics or nature of linolenic acid molecule in affecting the cholesterol properties are unknown (Horrobin & Manku, 1983). It had been postulated that any anti-hyperlipidemic agents could bind with the cholesterol metabolite bile acid in the liver, prior to cholesterol solubility being diminished.

The oxidative stress and lipid peroxidation have been the main cause of the reciprocal pathological mechanism in which case will reflect the current status and the condition of the kidney-liver. The degree of how serious is the condition of the kidney liver can be assessed or detected via blood biochemical analysis. The detailed summarized result of the kidney-liver was shown in Table 5. There were no significant changes in GGT, creatinine (Cr), urea and uric acid levels for the SM group and the treated group with *A. platensis*. Heidarpour *et al*. (2011) discovered that there was no significant change in BUN level even though the tested calves were fed with high doses of *A. platensis* (>25 g/d).

In the present experiment, the *A. platensis* had decreased the AST level from 15 to 18% in all the treated animal groups (AP, 2AP and 3AP) while the untreated group had their AST level being established throughout the experimental period (Table 6). This is in agreement with the result of the experiment carried out by El-Sabagh *et al*. (2013) on lambs in which the drop in AST level was 13%.

The AST, ALT and GGT of the hepatic serum function and specialize in signalling the problems of the liver whereby these enzymes are released into the blood as the result of cellular impairment or injury (Kovacs *et al*., 2003). However, ALT served as the most specific indicator of hepatic injury. GGT functions as a sensitive marker but not as specific as ALT (Al-Sultan, 2008). Table 7 shows there were an increase in the blood protein levels in the treated cows with *A. platensis* supplement with values of 12-13% increment. However, the other parameters viz. albumin, calcium (Ca), gamma glutamyl-transaminase (GGT) remain stable for both treated and non-treated cows throughout the experimental period. BUN and creatinine (Cr) levels are regarded as the preliminary diagnose of kidney injury. However, these determinations are not reliable at acute stage due to renal and non-renal factors

Table 5. Values of Blood Urea Nitrogen (BUN) and Creatinine (Cn) in the cow on 0, 15, 30 and 40 d of treatment and diet groups of cow (SM, AP, 2AP and 3AP)

	Time (d)	SM	AP	2AP	3AP
BUN urea ($mg.dL^{-1}$)	0	10.11 ± 1.65^{a}	6.71 ± 0.88^{b}	7.00 ± 3.7^{c}	16.5 ± 1.40^{d}
	15	8.72 ± 0.91^{a}	6.81 ± 0.65^{b}	6.89 ± 0.87^{c}	15.5 ± 1.73^{d}
	30	9.21 ± 0.88^{a}	6.56 ± 0.54^{b}	6.71 ± 0.66^{c}	15.0 ± 1.88^{d}
	40	8.10 ± 1.56^{a}	6.66 ± 0.81^{b}	6.31 ± 7.12^{c}	15.3 ± 1.58^{d}
Cn ($\mu mol.L^{-1}$)	0	71.3 ± 7.87^{ab}	84.5 ± 9.90^{ab}	131.9 ± 15.1^{c}	133.8 ± 13.3^{c}
	15	78.7 ± 5.21^{a}	71.6 ± 8.66^{a}	131.5 ± 14.6^{c}	131.9 ± 14.8^{c}
	30	81.9 ± 4.36^{a}	66.0 ± 7.21^{b}	123.9 ± 16.8^{c}	132.1 ± 15.1^{d}
	40	131.9 ± 13.3^{a}	68.8 ± 7.22^{b}	119.4 ± 13.8^{c}	128.2 ± 13.3^{c}
Urea ($mmol.L^{-1}$)	0	4.10 ± 0.87^{a}	2.40 ± 0.30^{b}	5.60 ± 0.61^{c}	5.48 ± 0.61^{c}
	15	4.78 ± 0.61^{a}	2.56 ± 0.21^{b}	5.71 ± 0.61^{c}	5.51 ± 0.61^{c}
	30	4.81 ± 0.36^{a}	2.71 ± 0.21^{b}	6.00 ± 0.77^{c}	5.61 ± 0.66^{d}
	40	4.90 ± 0.51^{a}	2.72 ± 0.22^{b}	6.01 ± 0.65^{c}	5.77 ± 0.65^{d}
Uric acid ($\mu mol.L^{-1}$)	0	185.3 ± 7.87^{a}	179.5 ± 19.9^{ab}	221.1 ± 22.1^{ab}	233.8 ± 13.3^{ab}
	15	178.7 ± 15.1^{ab}	171.6 ± 18.6^{ab}	233.2 ± 24.6^{ab}	231.9 ± 14.8^{ab}
	30	197.3 ± 14.3^{ab}	173.0 ± 17.2^{b}	223.9 ± 22.8^{bc}	232.1 ± 15.1^{bc}
	40	131.9 ± 13.3^{a}	168.8 ± 17.2^{b}	219.4 ± 23.8^{cd}	228.2 ± 13.3^{cd}

SM standard diet group; AP single amount supplement (2 g/10kg BW/d) diet group; 2AP twice amount supplement (3 g/10kg BW/d) diet group; 3AP trice amount supplement (4 g/10kg BW/d) diet group; Values (mean±SE) with different superscripts in the same row are significantly different at the 5% level, N=4; BW body weight.

Table 6. Values of Aspartate aminotransferase (AST) and Alanine amino-transferase (ALT) in the cow on 0, 15, 30 and 40 d of treatment and diet groups of cow (SM, AP, 2AP and 3AP)

	Time (d)	SM	AP	2AP	3AP
AST ($U.L^{-1}$)	0	73.8 ± 8.9^{a}	98.2 ± 7.3^{b}	82.6 ± 11.7^{c}	75.9 ± 10.5^{d}
	15	65.6 ± 15.8^{a}	92.1 ± 11.3^{b}	81.1 ± 7.8^{c}	71.5 ± 9.8^{d}
	30	71.2 ± 16.6^{a}	86.6 ± 12.6^{b}	75.6 ± 6.9^{c}	64.2 ± 8.9^{d}
	40	69.1 ± 16.6^{a}	82.8 ± 26.2^{b}	67.3 ± 16.1^{c}	63.9 ± 15.6^{d}
ALT ($IU.L^{-1}$)	0	55.6 ± 6.8^{ab}	58.8 ± 1.3^{ab}	58.7 ± 3.4^{ab}	61.4 ± 7.8^{ab}
	15	41.8 ± 5.9^{a}	54.1 ± 4.6^{b}	67.2 ± 3.3^{c}	57.5 ± 6.6^{d}
	30	53.2 ± 10.2^{ab}	55.6 ± 8.9^{b}	53.6 ± 10.4^{ab}	60.9 ± 10.4^{c}
	45	48.1 ± 7.7^{a}	49.8 ± 2.3^{b}	61.9 ± 13.8^{c}	51.8 ± 6.8^{d}

SM standard diet group; AP single amount supplement (2 g/10kg BW/d) diet group; 2AP twice amount supplement (3 g/10kg BW/d) diet group; 3AP trice amount supplement (4 g/10kg BW/d) diet group; Values (mean±SE) with different superscripts in the same row are significantly different at the 5% level, N=4; BW body weight.

Table 7. Values of total protein (TP), Albumin, Gamma GT and Calcium in the cows on 0, 15, 30 and 40 d of treatment and cow diet groups cow (SM, AP, 2AP and 3AP)

	Time (d)	SM	AP	2AP	3AP
Total Protein ($g.L^{-1}$)	0	67.9 ± 6.98^{a}	70.0 ± 9.11^{b}	71.2 ± 8.45^{b}	81.0 ± 6.41^{c}
	15	68.7 ± 6.31^{a}	75.1 ± 8.71^{b}	78.0 ± 7.32^{c}	85.5 ± 9.22^{d}
	30	63.7 ± 7.16^{a}	77.1 ± 8.82^{b}	79.4 ± 8.27^{c}	85.0 ± 8.92^{d}
	40	64.9 ± 7.36^{a}	78.7 ± 9.73^{b}	80.6 ± 7.21^{c}	91.6 ± 8.29^{cd}
Albumin ($g.L^{-1}$)	0	1.20 ± 0.13^{ab}	1.01 ± 0.17^{ab}	1.77 ± 0.15^{ab}	1.06 ± 0.21^{a}
	15	1.22 ± 0.21^{a}	1.04 ± 0.28^{b}	1.82 ± 0.12^{c}	1.05 ± 0.15^{b}
	30	1.31 ± 0.17^{a}	1.05 ± 0.23^{b}	1.81 ± 0.11^{c}	1.06 ± 0.15^{b}
	40	1.25 ± 0.17^{a}	1.06 ± 0.31^{b}	1.89 ± 0.21^{c}	1.09 ± 0.18^{bd}
Gamma GT ($U.L^{-1}$)	0	23.0 ± 0.02^{ab}	25.0 ± 2.51^{bc}	26.0 ± 2.01^{a}	26.0 ± 2.65^{ab}
	15	21.0 ± 0.07^{a}	24.0 ± 2.91^{bc}	27.0 ± 3.02^{c}	27.0 ± 2.02^{cd}
	30	20.1 ± 3.01^{a}	24.2 ± 2.03^{b}	27.0 ± 2.05^{c}	27.0 ± 2.09^{c}
	40	20.2 ± 2.24^{a}	24.0 ± 2.08^{b}	27.0 ± 2.09^{c}	27.4 ± 2.01^{cd}
Ca ($mmol.L^{-1}$)	0	2.00 ± 0.23^{a}	1.39 ± 0.27^{b}	1.35 ± 0.32^{bc}	1.60 ± 0.26^{d}
	15	1.95 ± 0.31^{ab}	1.59 ± 0.21^{b}	1.89 ± 0.33^{c}	1.89 ± 0.24^{c}
	30	1.73 ± 0.27^{a}	2.00 ± 0.27^{b}	1.88 ± 0.21^{cd}	1.80 ± 0.28^{d}
	40	1.71 ± 0.22^{a}	2.15 ± 0.15^{b}	1.97 ± 0.32^{cd}	1.91 ± 0.23^{d}

SM standard diet group; AP single amount supplement (2 g/10kg BW/d) diet group; 2AP twice amount supplement (3 g/10kg BW/d) diet group; 3AP trice amount supplement (4 g/10kg BW/d) diet group; Values (mean±SE) with different superscripts in the same row are significantly different at the 5% level, N=4; BW body weight.

(Elelstein, 2008). Addition analyses consideration such as glomerular filtration measurement, urine volume and tubular re-absorption rate are required (Deguchi & Akuzawa, 1997).

CONCLUSION

Until this present time, studies on the effectiveness of *A. platensis* and pre-clinical practice on the local female cattle seem to be scarce. This microalga has effectively increase the milk production and brought about added values to its nutrient. It also provided the betterment in the animal health, blood chemistry and growth performance. *Arthrospira platensis* had increased the HDL level and lowered the cholesterol as well as stabilized the BUN, LDL, creatinine and the ALT blood level without indicating any adverse effects towards kidney-liver function. As to the question of the *A. platensis* potential to be used for human and animal consumption necessitate its mass scale production to reach a huge productivity of greater than 3000 metric tonne annually in order to satisfy the global needs which is currently under supply.

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