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Dietary Supplements of Freeze-Dried Purslane Leaves Lower Serum Cholesterol in Growing Pigs

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Abstract: Purslane (*Portulaca* sp.), a vegetable known to be rich in omega-3 fatty acids and antioxidant vitamins was fed to young growing pigs to assess carcass and serum characteristics. The pigs were allotted into three groups: control CD, purslane+cholesterol CD-C-P) and cholesterol (CD-C). Purslane plus cholesterol group received a diet supplemented with 8% freeze-dried purslane leaves plus 0.5% added crystalline cholesterol. Cholesterol group received similar diet with only 0.5% added cholesterol while control group was fed the same basal diet of corn-soybean containing 23% crude protein. After 6 weeks of feeding trial, no significant differences were observed in body weight, liver, carcass, kidney, heart and gastrocnemius muscle weights. Feed intake, back fat, longissimus muscle, total lipids and protein content of gastrocnemius muscle and liver were not altered ($p>0.05$). Purslane fed group had a significant ($p<0.05$) increase in ash content of the muscle and a greater overall increase in serum High Density Lipoprotein (HDL) Cholesterol (HDL-C). There was a reduction ($p<0.05$) in total cholesterol and LDL-Cholesterol (LDL-C) in purslane group despite higher dietary cholesterol consumption. Serum total cholesterol was higher ($p<0.05$) in cholesterol group when compared to control group. Results suggest that purslane supplementation has hypocholesterolemic and/or hypolipidemic properties.

Key words: Purslane, pigs, hypocholesterolemic, omega-3 fatty acids, antioxidant vitamins

INTRODUCTION

Purslane is a ubiquitous garden weed in the United States. It is used for food or as an herb in other regions of the world. Its nutritional potential was first reported by Simopoulas and Salem (1986) that *Portulaca oleracea* was the richest vegetable source of omega-3 fatty acids. Subsequent reports have confirmed these results (Simopoulos *et al*., 1992; Omara-Alwala *et al*., 1991). Purslane also contains high levels of vitamin E, C and B-Carotene (Simopoulos *et al*., 1992) as well as essential macro and micronutrients (Mohamed and Hussein, 1994). The abundance of high levels of these essential nutrients in purslane suggests a potential to become a new source of nutritious food for both humans and livestock. Additional investigations showed that in spite of its genetic diversity, purslane remained one of the most abundant terrestrial vegetable sources of omega-3 fatty acids and other essential nutrients potentially beneficial for human and animal health (Ezekwe *et al*., 1999).

Purslane has been used as human food since prehistoric periods (Byrne and McAndrews, 1975; Chapman *et al*., 1974). It has been used in salads, soup, potherbs and pickling. Today, purslane is mainly harvested in the wild or produced in a kitchen garden rather than as an agriculture crop. However, in Europe an erect garden variety with a larger leaf has been developed and is commercially available (Simopoulos *et al*., 1995). Purslane can be beneficial whether eaten directly or indirectly from animal sources. Previous studies with laboratory animals showed that 10% dietary supplementation of purslane using a commercial rat chow was effective in reducing plasma cholesterol and triglycerides in rats (Ezekwe *et al*., 1995).

Further studies have shown that inclusion of 6 g of freeze-dried purslane leaves in the diet of hypercholesterolemic subjects significantly lowered plasma total cholesterol (LDL-C) and triglycerides accompanied by elevated HDL-C and blood hemotocrit levels (Ezekwe *et al*., 2001). These studies suggested that purslane leaves might have a potential to reduce blood lipids in hyperlipidemic humans.

Stewart *et al*. (2001) observed that a diet containing modified pork with high Polyunsaturated Fatty Acids (PUFA) significantly lowered total plasma and LDL-C in

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women thus suggesting that a new approach for modification of fatty acid composition in animal diets can serve as a useful approach to lowering the consumption of saturated fat and to improve the quality of pork products. There is a lack of information available on the effects of vegetable purslane in pigs. Though pigs are known to relish purslane to the best of the knowledge, no studies have been documented on its possible beneficial effects. Reduced cholesterol levels in pork will attract health conscious consumers who are anxious to reduce the cardiovascular disease risk factors and the ever-spiraling health care costs in the USA.

Therefore, the objectives of the present study were to determine the effects of freeze-dried purslane leaves supplementation in post-weaning growth, serum total cholesterol, LDL and HDL-C, carcass characteristics and chemical composition of skeletal muscle and liver.

MATERIALS AND METHODS

Animals and feed: Prior to the feeding trial, chemical analysis was performed to evaluate the nutrient composition in freeze-dried purslane leaves as shown in Table 1 and 2. All procedures involving handling and treatment of pigs were approved by the Animal Use and Care Committee at Alcorn State University. Eighteen post-weaning pigs of both sexes (barrows and females), from crossbred sows were randomly selected at 4 weeks old from a group of pigs housed in a pen for use in this experiment. Pigs were ear-tagged and weighed immediately after selection. They were then randomly allocated to three-treatment groups. Six animals were assigned to basal control diet, formulated from corn and soybean to contain 23.7% crude protein (National Research Council, 1998), purslane and cholesterol group. The purslane group was supplemented with freeze-dried purslane leaves (*Portulaca oleracea*) at the level of 8% with 0.5% crystalline cholesterol. The third group was fed the basal diet with added 0.5% crystalline cholesterol only (Table 3). The cholesterol level used in this preliminary study was intended to elicit adequate purslane response since cholesterol at normal level appears unaffected by purslnane supplements. Purslane plant was harvested fresh at full bloom (approximately 45 days after planting, Fig. 1). Purslane leaf material was kept frozen for the freeze-drying process in Freeze Dry System of Feezone (Labconco Corporation). Samples of freeze-dried purslane leaves were collected and kept in a refrigerator for later biochemical analyses. Cholesterol crystals (Fisher Scientific) were added at a level of 0.5% in the diet. Table 1 shows the ingredient composition of the three

Table 1: Mineral content (DM) in purslane leaves

Item[a]	Purslane
Phosphorus (%)	0.84
Potassium (%)	5.27
Calcium (%)	1.08
Magnesium (%)	1.22
Iron (ppm)	317.00
Manganese (ppm)	182.00
Zinc (ppm)	41.00
Copper (ppm)	6.00

[a]n = 2; Analysis performed by Mississippi State University extension service (Mississippi State, MS)

Table 2: Chemical composition (DM) of purslane leaves

Item[a]	Concentration
Crude protein (%)	22.90
Crude fiber (%)	2.17
Ash (%)	27.00
Total lipids (%)	6.90
Pectin (%)	19.60
Vitamin C (ppm)[1]	68.30
Vitamin E (mg/100 g)[1]	17.90
B-Carotene (IU kg^{-1})	53,842.30

[a]n = 2; [1]Analysis performed by Ralston Analytical Lab, St. Louis, MO

Table 3: Composition (As fed) of the experimental diet (CP 23.7%) for 5-10 kg pigs

	Treatment groups		
Ingredients (%)	Purslane	Cholesterol	Control
Corn	53.60	58.94	59.54
Soybean meal	35.80	38.44	38.34
Salt	0.25	0.25	0.25
Vit-premix[a]	0.25	0.25	0.25
Limestone	0.90	0.90	0.90
Dical-phosphate	0.71	0.71	0.71
Purslane	8.00	-	-
Cholesterol	0.50	0.50	-
Antibiotics	0.01	0.01	0.01
ME (kcal kg^{-1})	3160.00	3238.00	3256.00
Analyzed composition (DM)			
CP	26.80	27.10	26.40
Ash	8.40[b]	6.10[c]	6.80[d]

[a]Provided (per kilogram of Premix) 2,204,585.5 IU Vit A; 440,917 Vit D_3; 4,409.2 IU Vit E; 6.7 mg Vit B_{12}; 222.2 mg Menadione; 38,553 mg Choline; 5,555 mg Niacin; 3,777.8 mg D-Pantothenic acid 1,222.2 mg Riboflavin and 411 mg Thiamin. Provided (% of premix) Ca = 11.5; Col = 012; I = 0.011; Fe = 3.2; Mn = 0.12 and Se = 0.12%; [b-d]Differ significantly ($p<0.05$)

Fig. 1: Purslane (*Portulaca oleracea*) plant

experimental diets. All diets were isocaloric and isonitrogenous. Treatment groups were placed in separate

concrete pens with a floor space of 20 m^2 under the same roof. Each pen was supplied with a commercial feeder for group feeding and two nipple drinkers for a continuous water supply. Feed intake and body weight recorded over time were used to calculate the overall means reported.

Experimental procedures: Pigs were fed on *ad libitum* for the total of 8 weeks with 2 weeks acclimation period during which all groups were fed the control diet. Feed intake was recorded daily and pigs were weighed weekly for the entire experimental period. Blood samples were collected via the anterior vena cava at the initiation of the experiment at weekly intervals and at 24 h before slaughter. Blood were centrifuged in a refrigerated centrifuge (Marathon 26 KMR Centrifuge, Fisher Scientific) for 10 min at 5000 rpm. Serum samples were collected and frozen at -40°C for further biochemical analysis.

At the end of the experiment, all pigs from each treatment were slaughtered at Southern University, Baton Rouge Meat Laboratory. Carcass weights of all slaughtered pigs were recorded immediately after dressing. Carcass measurements taken included loin eye area of the left side, mean of the backfat taken at the first rib, last lumbar and the last rib, the gastrocnemius muscle from the left hind leg. Internal organs were dissected, weighed and sampled from each pig included the livers, heart and kidneys. Liver and muscle samples were frozen at -40°C for further laboratory analysis.

Laboratory analysis: Chemical composition of feed, livers and muscle samples were determine by the AOAC (1995) methods. Proximate analysis of proteins in feed, liver and muscle samples was performed using the Buchi Kjeldahl Line Digestion Unit (Buchi B324, Switzerland) followed by distillation and titration.

Purslane leaves were analyzed for crude protein, crude fiber (residue left after a sample was boiled in weak acid and then in weak alkali), total lipids, dry matter and ash (AOAC, 1995). The concentration of calcium, phosphorus, potassium, magnesium, iron, manganese, zinc and copper in the leaves of purslane were determined by inductive couple plasma atomic emission spectroscopy as described by Winge *et al*. (1985). Vitamin C, vitamin E and β-carotene were analyzed by High-Performance Liquid Chromatography (HPLC) by a commercial laboratory (Ralston Analytical Lab, St. Louis, MO). Pectin from purslane was extracted and characterized as described by Phatak *et al*. (1988). Crude fiber in purslane was analyzed using Ankom Fibre and analyzer.

Total fat content of feed, leaf and pig tissue samples were analyzed using hexane and chloroform, respectively by a modified one-step methylation method as described by Sukhija and Palmquist (1988). For pig tissue samples, approximately 0.5 g of ground sample was transferred into culture tube. About 1 mL chloroform and 1.5 mL of freshly made 5% methanol HCL were added into each tube. Tubes were capped tightly and vortexed slowly for approximately 1 min.

Then, the tubes were placed in a water bath at 70°C for 2 h, cooled to room temperature then 2 mL of 6% potassium carbonate (K_2CO_3) was added. The content of the tube was washed down with 1 mL chloroform, vortexed for 30 sec at medium speed and centrifuged for 10 min at 2,500 rpm. After centrifugation, a lower chloroform layer was carefully removed by piercing the floating tissue residue at the edge of the tube without disturbing the upper or lower layers. The collected solvent was transferred into new tubes and dried down under nitrogen gas.

The content was washed down with 2 mL hexane and approximately 0.4 g of anhydrous sodium sulfate (Na_2SO_4) was added for dehydration. Tubes were vortexed and centrifuged for 10 min at 2,500 rpm. A new set of culture tubes were marked, weighed and their weight recorded as initial weight. An aliquot of the combined hexane portion from the centrifuge was transferred into new tubes and dried down under nitrogen gas. Tubes and their contents were weighed and recorded for the final weight. The final weights were subtracted from their corresponding initial weight of total fat extracted. Percentage of total fat extracted was obtained. Total cholesterol and HDL-cholesterol in serum were determined using *in vitro* colorimetric method of Wako (Wako Chemicals USA inc.). LDL cholesterol was calculated using the following formula: total cholesterol-HDL cholesterol-Trigly-ceride/5.

Purslane freeze-dried leaf sample was analyzed for fatty acid composition by a commercial laboratory. Freeze-dried sample of purslane leaves was shipped to the laboratory (Midwest Laboratories, Omaha, Nebraska) for fatty acid profile using the GC-FAMES Method. A mixed standard of FAME's C_6 though $C_{24:1}$ was prepared by diluting the contents of the glass vial to final volume of 5 mL in hexane.

Statistical analysis: Statistical analysis was accomplished by General Liner Models and One Way Analysis of Variance using Statistix 7.0 Analytical Software for Windows (Statistix in 2000). Serum treatment responses over time were determined and the means were separated by Duncan's multiple rang test. Orthogonal and

polynomial contrasts were used to evaluate the effects of purslane on serum cholesterol over time. Significant differences were determined at the level of $p<0.05$.

RESULTS AND DISCUSSION

Table 1 shows the chemical composition of the freeze-dried purslane leaves. The crude protein content of purslane (22.9%) compares well or higher than those of other forage or vegetable crops like alfalfa and legumes traditionally used animals feed (Wilson *et al*., 1978; Watkins and Kearns, 1956). Purslane showed an extraordinary nutrient composition in the tissues as compared to other commonly consumed vegetable (Omara-Alwala *et al*., 1991). Ash, total lipids, pectin and antioxidant content were higher than those of other vegetables (Omara-Alwala *et al*., 1991). The crude fiber content of 2.1% did not pose any threat to nutrient digestibility in the pig when compared with 24% crude fiber (National Research Council, 1998) commonly fed and are digestible in pigs. The results also showed considerable amounts of antioxidants with levels as high as 68.3 ppm, 17.9 mg/100 g and 53,842.3 IU of vitamins C, E and β-carotene, respectively. The uniquely high antioxidant vitamins in purslane in addition to its high levels of soluble fiber (pectin), make this plant potentially beneficial as a functional food product for health conscious consumers. Human trial with purslane supplements has confirmed the beneficial effects of purslane as a functional food product (Besong *et al*., 2011).

Of the eight minerals reported in this study, their concentrations are superior or similar to levels present in commonly consumed vegetabls. With this abundance of minerals, purslane may alleviate skeletal mineral insufficiency in pigs supplemented with purslane leaves.

Pigs adjusted rapidly to experimental diet and readily consumed the feed. Table 4 shows feed intake overall means over time by the three groups of pigs from week 1 through the end of the experiment. Purslane fed group (CD-C-P) consumed 12% less feed than the other experimental groups without compromising body weight gain and feed efficiency. The supplementation of the diet with purslane did not adversely affect the overall performance of pigs.

The carcass characteristics and organ weights from experimental pigs are shown in Table 5. There were no differences ($p>0.05$) in carcass weight, lion eye area, back fat thickness and organ weights among the groups. Though statistical differences were not evident in back fat among the groups, the CD-C-P pigs had 50 and 40% less back fat than CD-C and CD pigs (0.3 vs. 0.6 and 0.5 cm), respectively. Skeletal muscle and liver composition were

Table 4: Body weights, feed intake and ADG in pigs supplemented with purslane and cholesterol

	Dietary treatments		
Item[1]	Purslane	Cholesterol	Control
Body weight[a] (kg)	22.5±1.50	23.3±1.40	23.10±1.40
ADG[a] (kg)	0.6±0.05	0.6±0.04	0.50±0.05
Feed intake[a] (kg)	73.7±10.0	82.6±10.2	83.30±9.80
Feed efficiency	3.1	3.6	3.80

[a]Values are mean±SE for six animals. [1]Items do not differ significantly ($p>0.05$)

Table 5: Carcass characteristics and organs weights of pigs supplemented with purslane and cholesterol during growth period

	Dietary treatments		
Items[a]	Purslane[1]	Cholesterol[1]	Control[1]
Carcass weight (kg)	24.0±1.60	25.2±1.80	24.9±1.70
Loin eye area (cm^2)	17.3±0.90	16.6±0.80	17.2±1.60
Back fat thickness (cm)	0.3±0.09	0.6±0.08	0.5±0.10
Kidney (g)	172.5±22.3	172.5±24.2	162.5±25.4
Heart (g)	167.5±8.10	162.5±11.8	158.3±11.6
Liver (g)	680.8±22.4	615.8±37.8	635.8±38.5
Gastrocnemius muscle (g)	185.0±16.2	178.3±13.5	185.0±9.90

[1]Values are means±SE for six animals; [a]Items do not differ significantly ($p>0.05$)

Tabe 6: Chemical composition DM (%) of muscles and liver in pigs supplemented with purslane and cholesterol during the growth period

	Dietary treatments		
Item	Purslane[1]	Cholesterol[1]	Control[1]
Livers			
DM	30.60±0.6	30.1±0.23	30.6±0.33
Ash	6.23±0.2	6.6±0.20	6.2±0.20
Total lipids	9.20±0.9	9.6±0.50	10.8±0.80
Crude proteins	52.60±1.1	54.1±0.80	535.0±0.80
Muscles			
DM	26.20±0.3	27.1±0.50	26.3±0.20
Ash	9.50±0.7[a]	6.8±0.50[b]	7.5±0.80[ab]
Total lipids	7.20±0.8	6.4±0.50	7.3±0.90
Crude proteins	67.60±1.8	65.3±2.20	66.3±1.80

[1]Values are means±SE for six samples from each group. [2]Variables do not differ ($p>0.05$). [a,b]Means with different superscript differ ($p<0.05$)

shown in Table 6. The ash content of gastrocnemius muscle in CD-C-P group was significantly higher ($p<0.05$) than the CD-C group with no differences between the CD and CD-C animals. Ash content in purslane diet (Table 3) reflected the higher ($p<0.05$) value in skeletal muscle in CD-C-P group. The CD-C-P diet was comparably accepted by growing pigs as shown by similar ($p>0.05$) levels of feed intake during the experimental period (Table 4). The 40-50% less back fat in CD-C-P pigs indicates that purslane may regulate the level of adiposity in pigs at later stages of development when fat deposition dominates growth activity.

The response of serum total cholesterol in CD-C-P and CD-C groups showed significant ($p<0.05$) differences as compared to the control (Fig. 2). The graph shows the response of pigs subjected to purslane plus cholesterol diet >6 weeks feeding period. The graph shows similar

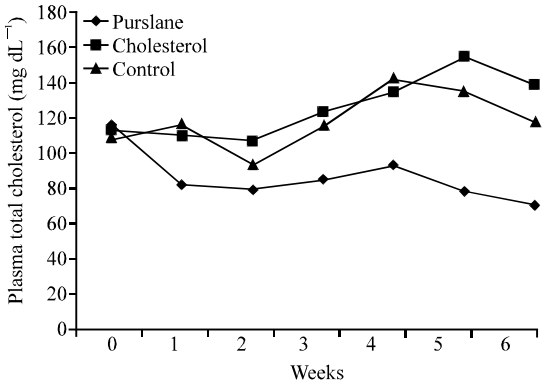

Fig. 2: Plasma total cholesterol (mg dL^{-1}), values are means for six animals

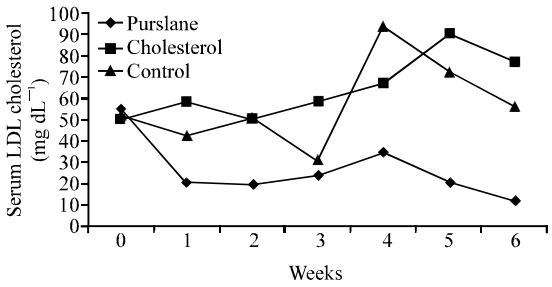

Fig. 3: Serum LDL-cholesterol (mg dL^{-1}), values are means for six animals

levels of total cholesterol at week 0 at week 1 through week 6, purslane fed animals showed a significant reduction ($p<0.05$) in total cholesterol. No differences were observed between the cholesterol group and the control group. As expected, total serum cholesterol was higher ($p<0.05$) in CD-C pigs and lower ($p<0.05$) in CD-C-P group when compared to CD. At the initiation of the experiment (day 1) serum total cholesterol was similar among the three groups (116.6, 113.3 and 108.7 mg dL^{-1} for CD-C-P, CD-C and CD groups, respectively). However, overall mean for total cholesterol was reduced ($p<0.05$) in CD-C-P (86.8±2.7) when compared to CD-C (126.2±3.1) or CD (118.5±3.1) mg dL^{-1} group. Total cholesterol was also higher ($p<0.05$) in CD-C than in CD group. At the end of experiment, CD-C-P group showed a 39% reduction in total serum cholesterol whereas the CD-C and CD groups increased by 23 and 9%, respectively. No differences were observed between CD-C and CD fed animals. Trend comparison for total cholesterol showed that purslane had significant ($p<0.05$) linear and quadratic effect on total cholesterol level. Plasma cholesterol in pigs varies with age and diet with its concentration particularly high in suckling pigs because of the relatively high concentration in milk Mesmann *et al.* (1979). The values obtained in this study were in agreement with those of Mesmann *et al.* (1979) for pigs of similar age. As in humans, pigs reach a balance by adjustment of endogenous synthesis to the dietary cholesterol intake (Hackman *et al.*, 1996). The linear and quadratic decrease in total cholesterol level in purslane fed pigs was similar to results obtained Ezekwe *et al.* (1995) in laboratory rats fed freeze-dried purslane. A recent study with cholesterol fed rabbits demonstrated that serum total cholesterol was significantly reduced in rabbits fed purslane extract (Movahedian *et al.*, 2007). The ability of purslane to reduce total cholesterol in spite of added dietary cholesterol indicated its strong hypocholesterolemic potential. Its ability to alter blood lipid metabolism in hypercholesterolemic subjects has been demonstrated (Besong *et al.*, 2011). Figure 3 shows the response of LDL-cholesterol to dietary purslane supplementation. The graph shows changes in serum LDL-cholesterol in pigs fed purslane + cholesterol and control diets. Differences between the pre-treatment and post-treatment levels were indicated at weeks 1, 2, 3, 5 and 6 for purslane fed pigs. Overall means were significantly lower ($p<0.05$) in purslane and control groups than in cholesterol group. LDL-cholesterol was less ($p<0.05$) in CD-C-P pigs. Effect of treatment, time and treatment x time interaction were highly significant ($p<0.01$). There was a 78.5% reduction in LDL-cholesterol within 7 days of treatment in CD-C-P animals while CD-C and CD groups showed an increase of 54 and 8%, respectively. Overall means for LDL-C was 26.6±1.3, 64.3±1.9 and 57.1±1.5 mg dL^{-1} for CD-C-P, CD-C and CD, respectively. LDL-C in CDC-P differed ($p<0.05$) from those of CD-C and CD while those of CD-C and CD remained unaltered ($p>0.05$). Lowering LDL-cholesterol has been advocated to prevent coronary heart disease (Lawerence *et al.*, 1989). Purslane was effective in lowering plasma LDL-cholesterol and increasing HDL-cholesterol in hypercholesterolemic humans (Ezekwe *et al.*, 2001). The pectin concentration in purslane (Table 2) may in part, be responsible for reduction in cholesterol levels observed in the present study. Addition of pectin has resulted in lower serum and liver cholesterol in laboratory animals (Fernandez *et al.*, 1997). The mechanism of action of pectin in lowering serum cholesterol is not fully understood but is likely due to the binding of bile acids in the intestinal lumen and subsequently excreting the metabolite as fecal acids.

Serum HDL-C (Fig. 3) was increased ($p<0.05$) in CD-C-P group when compared to the other 2 groups. Serum HDL-C was similar among the three experimental groups at 1 and 42 days of the experiment. HDL-C responded to purslane supplementation with an increase

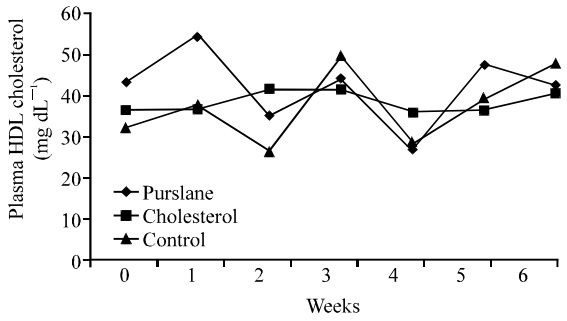

Fig. 4: Serum HDL cholesterol (mg dL^{-1}), values are means for six animals. Linear effect of purslane feeding ($p<0.05$)

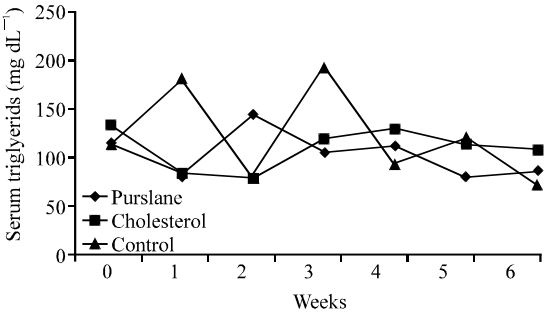

Fig. 5: Serum tiglycerides (mg dL^{-1}), values are means± for six animals

of 42% within week 1. Overall mean values for HDL-cholesterol showed that CD-C-P animals had higher ($p<0.05$) concentration (41.0±2.2) than the control group (36.7±1.4) with no differences between the CD-C-P and CD-C groups (38.3±0.9 mg dL^{-1}). Trend analysis (Fig. 4) showed that purslane supplements had a significant ($p<0.05$) linear effect on HDL-C. The graph shows the response of pigs subjected to purslane diet plus cholesterol, cholesterol and control diets. Similar levels of HDL cholesterol were noted at week 0, week 1 and 5, purslane group showed a significant increase in HDL cholesterol at week 2 and 4 while cholesterol and control groups showed a reduction in HDL-cholesterol. Overall means were higher in purslane ($p<0.05$) group than in the control. The cholesterol group differed significantly from the control group during week 2. HDL-C, often called good cholesterol for its ability at high levels to pick up cholesterol from other lipoproteins and transport to the liver for disposal is associated with a reduction in heart disease. Increasing levels of HDL-C were associated with less coronary calcification and a smaller probability of having any calcified disease, supporting the antiatherogenic hypothesis for HDL-C (Dean *et al*., 2004; Allison and Wright, 2004).

Overall serum triglycerides concentrations were less ($p<0.05$) in CD-C-P animals (103.6±1.3) than in the CD (123.6±1.8), no differences were observed between CD-C-P and CD-C (109.6±1.7 mg L^{-1}) or between CD-C and CD groups (Fig. 5). The graph shows changes in serum triglycerides (mg dL^{-1}) in growing pigs fed purslane, cholesterol and control diets for 6 weeks. Overall means were significantly lower ($p<0.05$) in purslane than in cholesterol and control diet fed groups. Control and cholesterol fed groups values differ ($p<0.05$) in serum triglycerides. The ability of purslane leaf supplement to reduce both cholesterol and triglycerides in treated animals suggested the presence of more than one active biological factor. It has been demonstrated that dietary ω-3 fatty acids rich-flax seeds do not lower plasma cholesterol in animals (Cherian *et al*., 1996). Pigs fed diets containing various levels of 18:3ω-3 fatty acids did not alter plasma cholesterol concentrations but plasma triglycerides were reduced (Cherian *et al*., 1996). Therefore, the biological activity of purslane leaves in lowering plasma cholesterol and triglycerides is most likely due to the presence of ω-3 fatty acids, antioxidant vitamins and pectin abundant in purslane leaves. The high pectin content in purslane in the present study was in agreement with those of Wenzel *et al*. (1990). Pectin fed to rats at 7 g/100 g of diet lowered hepatic bile acid and cholesterol synthesis as well as serum cholesterol (Fernandez *et al*., 1997). Similar effects of pectin were reported in rats (Arjamandi *et al*., 1992).

CONCLUSION

Purslane could be important for American agriculture and for human and animal nutrition. The present study has demonstrated the potential for purslane to provide nutritional as well as hypocholesterolemc benefits in animal species. More studies are needed to fully domesticate purslane for effective economic and dietary application. Its role in reducing the risk of cardiovascular diseases in humans and improving pork quality needs to be further explored.

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