



CASE REPORT

The beneficial roles of *Lupinus luteus* and lifestyle changes in management of metabolic syndrome: A case study



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Abstract Metabolic syndrome (MetS) is a cluster of cardiovascular risk factors including obesity, hypertension, dyslipidemia and hyperuricemia. Here, we report a 43-year-old man with obesity, hypertension, hypercholesterolemia, hyperuricemia and mild liver dysfunctions. Lupin (*Lupinus luteus*) and therapeutic lifestyle change (TLC) were suggested as therapeutic intervention for the present case for 6 months. The body weight, body mass index (BMI), blood pressure, total cholesterol (TC), low density lipoprotein-cholesterol (LDL-C), triacylglycerol (TAG), uric acid (UA) and alanine transaminase (ALT) were markedly decreased by 26.85%, 26.95%, 13%, 53.84%, 57.84%, 36.14%, 47.58% and 61.62% respectively, compared to those at baselines. However, high density lipoprotein cholesterol (HDL-C) value was markedly increased by 30.77%. The present results concluded that administration of lupin with TLC is good intervention for prevention and treatment of MetS.

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1. Introduction

Metabolic syndrome (MetS) represents a cluster of cardiovascular risk factors including obesity, hypertension, dyslipidemia and insulin resistance. Obesity is a problem faced by many societies and it constitutes the main cause of MetS (Mottillo et al., 2010). In most communities unhealthy diets and sedentary lifestyle are the main risk factors for the development of obesity (Kelly, 2010). On contrary, balanced diets, regular exercise and body weight control are essential for health quality (Chitra et al., 2012). Diet and lifestyle are major modifiable of hypertension, dyslipidemia, diabetes and obesity.

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They should be targeted for the prevention of MetS (Bulló et al., 2013). The therapeutic lifestyle changes (TLC) suggested that obtaining up to 35% of daily calories from fats, restricting saturated fats in the diet and regular aerobic exercise at least 120 min/week (Kelly, 2010).

Diet rich in proteins produce a satiating effect and help stave off hunger during dieting. Consumption of excess animal protein may increase the incidence of obesity, cardiovascular disease and bovine spongiform encephalopathy (Arnoldi and Greco, 2011). However, eating of more plant-based foods lowers rates of many chronic diseases (Duranti, 2006). This is attributable to they contain, trace elements, folate, antioxidant agents and anti-nutritional factors (ANF) (Duranti, 2006). Therefore, smart dieters must choose the best sources of protein available to lose weight, and stay healthy.

Many studies indicate that people who eat legumes regularly are more likely to lower risk of obesity (Papanikolaou and Fulgoni, 2008). Yellow lupin (*Lupinus luteus*) contains 30–35% protein, 30% fibers, 3–10% carbohydrate and 6% fats. As well, lupin contains a high percent of macro-elements such as phosphorus, calcium and magnesium as well as micro-elements such as zinc, copper, chromium and cobalt (Arnoldi and Greco, 2011; Duranti, 2006; Písařiková and Zralý, 2009). Also, lupin contains ANF including indigestible oligosaccharides, amylase inhibitors, trypsin inhibitors, quinolizidine alkaloids, tannins and lectins. Furthermore, lupin was characterized by absence of phytoestrogens, low level of sodium and low glycemic index (Arnoldi and Greco, 2011; Písařiková and Zralý, 2009).

In the present case study, lupin was recommended as intervention beside TLC for treatment of MetS.

2. Case report

2.1. Case history

A 43-year-old man is a member of academic staff (Biochemist) nonsmoker and non-alcoholic drinker. The man has bad dietary habit, low physical for 6 years ago, and he seems in a good health without medical complaints. He comes to the academic staff clinic at KKHU for physical examinations and blood test, as control participant in a study about cardiac health. The anthropometric measures revealed that his body mass index (BMI) was 34.09 kg/cm², and his blood pressure was 152/90 mm Hg. In addition, his blood laboratory report indicated that there are elevations of total cholesterol (TC), low density lipoprotein cholesterol-C (LDL-C), alanine aminotransferase (ALT) and uric acid (UA) and were out of the reference range. However the kidney function tests were in the normal range.

2.2. Diagnosis

With respect to the obtained results, primary care doctor indicated that the case in unhealthy condition obesity grade-1, hypertension stage-1, hypercholesterolemic, hyperuricemic with mild liver dysfunctions. The doctor indicated that these conditions are predisposing risk factors for MetS. Therefore, the patient must put on the therapeutic TLC for at least 6 months. TLC intervention includes smart diets, and regular exercise.

2.3. Dietary and TLC protocol

Smart diets are rich legume protein (smart protein) low in carbohydrate, low in animal fats and animal proteins. The daily dietary program consists of crude yellow lupin (*L. luteus*) at about 100 g/day, carbohydrate (200 g/day), and animal protein (50 g/day) and fat (50 g/day) as well sugar free hot beverage according to need. The caloric content of this diet is about 1600 kcal. The vegetables and fruits are prescribed as snacks *ad libitum*. Vegetables include reddish, lettuce, carrot, tomato, cucumber, red cabbage and low caloric fruits such as apple and organ. Also, the case performed aerobic training (running) at least 2 h after meals for 45–90 min/5 sessions/week. This protocol was performed for 6 months.

3. Results and discussions

Table 1 shows the physical examination and laboratory report of the case at first visit to clinic after 3 months as well as after 6 months. It is revealed that after 6 months of lupin intake and TLC, body weight, body mass index (BMI), blood pressure, total cholesterol (TC), low density lipoprotein-cholesterol (LDL-C), triacylglycerol (TAG), uric acid (UA) and alanine transaminase (ALT) were markedly decreased by 26.85%, 26.95%, 13%, 53.84%, 57.84%, 36.14%, 47.58% and 61.62% respectively, compared to those at baselines. However, high density lipoprotein cholesterol (HDL-C) value was markedly increased by 30.77%. Baseline results indicated that this case suffered from MetS including obesity grade-1, hypertension stage-1, hypercholesterolemia, hyperuricemia and liver dysfunctions.

The MetS, is a disorder that needs multi-factorial intervention including TLC, and sometimes required drug interventions. The dietary management of obesity was varied with daily calorie intake between 1400 and 1900 kcal depending on the grade of obesity. Low carbohydrate diet more favorably compared to low fat diet (Arora and McFarlane, 2005). A dietary management combined with exercise decreases subcutaneous fats, visceral fats and normalizes the distribution of abdominal fat (Togashi et al., 2010). A dietary reduction plus physical activity around 3 h weekly improved body composition and general health (Fett et al., 2005).

In the existing case study the effect of diet regimen and aerobic exercise on body weight and BMI in agreement with the study of Peters and Leblanc (2004), who reported that low diets carbohydrate and exercise are connected with body weight loss. Low carbohydrate intake modulates several metabolic, hormonal adaptations and increased lipolysis and fat oxidation (Peters and Leblanc, 2004). In these situations, depot fats, intramuscular glycogen, and free fatty acids were catabolized as sources of fuel for muscle contraction (Peters and Leblanc, 2004). Furthermore, aerobic exercise decreased lipogenesis and activated lipoprotein lipase that increased lipolysis, therefore, fat clearance and burning were increased (Plaisance and Fisher, 2014). Therefore, carbohydrate restriction resulted in appetite reduction, and weight loss.

An earlier study confirmed that a low glycemic index diet has a role in the management of obesity via increasing the satiety value of food and modulation of appetite (Warren et al., 2003). Herein, the intake of lupin concurrent with low

Table 1 Physical examination and laboratory report of the case at first visit to clinic after 3 months as well as after 6 month.

Test	Baseline	After 3 month	After 6 month	Reference values
Height	178.0	178.0	178.0	–
Weight	108.0 ^a	91.00 ^{a,b}	79.00 ^{b,c}	–
BMI	34.09 ^a	29.04 ^{a,b}	24.90 ^{b,c}	18.5–24.99 kg/m ²
SBP	152.0 ^a	140.0 ^{a,b}	130.0 ^{b,c}	< 120 mm Hg
DBP	90.00 ^a	85.00 ^{a,b}	78.00 ^{b,c}	80 mm Hg
FBG	4.700	5.000 ^a	4.800 ^c	3.9–5.8 mm
HbA _{1c}	6.200	5.400 ^b	5.700	3.9–6.7%
TC	6.500 ^a	4.900 ^b	3.500 ^{b,c}	3.2–5.2 mmol/L
HDL-C	1.430	1.870 ^d	1.970 ^d	0.8–1.63 mmol/L
TAGs	1.190	0.620 ^b	0.760 ^c	0.5–2.27 mmol/L
LDL-C	4.530 ^a	2.750 ^b	1.910 ^{b,c}	1.81–4.29 U/L
ALT	86.00 ^a	32.00 ^b	33.00 ^b	20–65 U/L
UA	454.0 ^a	369.0 ^b	238.0 ^{b,c}	210–420 U mol/L
Calcium	2.300	2.300	2.300	2.1–2.55 mmol/L

^a Indicated that test value is higher than that of reference range.

^b Indicated that test value is lower than that at baseline.

^c Indicated that test value is lower than that after 3 month.

^d Indicated the values higher than baseline.

carbohydrate diet induced body weight reduction. Similarly, [Arnoldi and Greco \(2011\)](#), reported that lupin has a low glycaemic index due to the presence of ANF that may decrease the digestion and absorption of food stuff. Also, the presence of high percent of calcium and chromium lupin may associate with the beneficial effects on body weight ([Arnoldi and Greco, 2011](#); [Pisařiková and Zralý, 2009](#)).

Low calorie diet is effective in improving glycaemic control and blood lipids through weight loss ([Harder et al., 2004](#)). In the present case study, the improvement of lipid profile was similar to the study of [Arora and McFarlane \(2005\)](#), who reported that body weight reduction was associated with reduction in TAG, and of LDL-C as well as increase in HDL-C. It has been reported that lupin upregulates LDL receptors, and down regulates cholesterol biosynthesis genes ([Fontanari et al., 2012](#)). The same author added that, lupin interferes with cholesterol enterohepatic circulation and decreases the accumulation of fat in the liver. Likewise, [Marchesi et al. \(2008\)](#), established the role of lupin as hypolipidemic and anti-atherosclerotic agent. Therefore, consumption of lupin concurrent with TLC reduced the levels of TC, LDL-C, TAG and ALT. Several earlier studies confirmed the beneficial effects of lupin on lipid profile ([Arnoldi and Greco, 2011](#); [Pisařiková and Zralý, 2009](#)).

The obesity and overweight are predisposing factor for hyperuricemia. The decrease of UA level during TLC of the present case runs parallel to [Krzystek-Korpaczka et al. \(2011\)](#), who reported that the longitudinal weight reduction program encompassing diet/exercise with was efficient in reducing the UA level.

Lifestyle modifications improve nitric oxide as a vasodilator suggesting that the beneficial effect of lifestyle modification on hypertension ([Maeda et al., 2013](#)). The effect of TLC on blood pressure of the present case confirmed these results. Lupines are one of the best natural sources of L-arginine as nitric synthase substrate ([Pisařiková and Zralý, 2009](#)). This gives lupin positive impact on anti-hypertensive agent. Similarly, [Bähr et al. \(2013\)](#), reported that of lupin protein elicit beneficial influence on blood pressure. The improvement of the patient

lipid profile and UA levels has beneficial effects on blood pressure. Moreover, drinking of excess cold water induced diuresis.

Finally, unbalanced diets coupled with a sedentary lifestyle are a prescription for disasters (MetS). By contrast, healthy diet rich in plant protein, low in carbohydrate, and fat, and regular exercise were used as alternative drug choice to treat MetS. [Carroll and Dudfield \(2004\)](#) reported that TLC treatment of MetS improves the cluster of metabolic risk factors.

4. Conclusion

This study concluded that correction of BMI, blood pressure, lipids abnormality of this case at the end of (6 months) confirmed the role of smart diet, lupin, and regular exercise in treatment of MetS. The dietary advice, monthly body weight checking, testing of lipids profile and liver functions every 6 months are essential as points of care testing.

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