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Efficacy of *Moringaoleifera* Leaf Powder as Nutrigenomic Therapy: A Preliminary Study of Madura Islands Variety

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Abstract

Malnutrition and metabolic disease are the major problem of global population during the last few decades. The increasing of infant mortality related under caloric protein diet was reported in the developing countries. Moreover, metabolic perturbation caused by nutrient deficiency is the advanced physiological complication associated malnutrition. In addition, by contrast, an excess caloric intake is not only the common problem in the Western countries, but also becoming emerging metabolic disease in the low income countries. Thus, the exploration of a reliable nutritional therapy derived from local biodiversity is required. *Moringa oleifera* is a tropical and subtropical plant that widely spread in equatorial region. Moringa is a traditional medicinal plant rich in nutrition due to the presence of some essential nutrients in its leaves. Even though some previous studies have been done to investigate the potential ingredients and benefits of Moringa leaf powder, however the exploration of nutritional values of *Moringa oleifera* Sumenep Madura variety is unknown. This study was conducted by using proximate analysis of nutritional ingredients within Moringa leaf powder obtained from two varieties of Sumenep Madura and Kupang East Nusa Tenggara. Our laboratory data showed that Moringa leaf powder Sumenep Madura variety A has a higher level of protein (29.720 %), fat (4.971%), carbohydrate (38.417%), and vitamin C (985.305 mg/100g). Importantly, the similar pattern of nutritional ingredients was observed in variety B (32.865 % of protein levels, 4.707% of fat concentration, 36.784% of carbohydrate, and 1050.575 mg/100g of vitamin C). In summary, the findings from our preliminary study provide novel evidence the potential nutrients within Moringa leaf powder Sumenep Madura variety. It is possible that to propose this local Moringa as an additional future nutrigenomic therapy combating malnutrition and metabolic diseases.

Keywords: *Moringa oleifera, malnutrition, metabolic diseases, Madura variety*

1. INTRODUCTION

Malnutrition and metabolic syndrome are the major social economic problem of worldwide population. The highest incidence of infant mortality was become an emerging health problem in the developing countries (1). Metabolic perturbation caused by nutrient deficiency, in particular for

under caloric protein diet is the major cause of physiological complication associated malnutrition. Increased of child mortality rate is related to the limitation of the poorest community to a high quality food access or supply. The correlation of poverty, poor health and poor nutrition were established affect to the general welfare of the population and significantly associated with population nutritional insecurity (2). It is estimated that more than 143 million children under the age of five were developed to chronic undernutrition (3). The severity of malnutrition in younger population exacerbated physiological abnormalities, including systemic infection, impaired liver function, gastrointestinal disorder, and electrolyte imbalance. Indeed, in Indonesia there was reported that the prevalence of undernutrition significantly increased during last two decades (4). The number of national undernutritional prevalence gradually increased in 2003 to 2006 (5). However, by contrast, in recent situation an excess caloric intake/overnutrition is also the common problem in the low income countries. Increased obesity linked T2DM incidence has become a new trend in Asian younger population (6).

Several studies have shown that the rapid changes of body mass index (BMI) resulting in the higher risk of diabetes in the Asian population during the last decade (7). Obesity has a positive correlation with adipogenesis implicate to insulin resistance, type 2 diabetes (T2DM), hypertension, and vascular complications (8). The gradual changes of physical activity, sedentary lifestyle, and overnutrition resulted in the high prevalence of obesity. Moreover, the increased obesity prevalence was also observed in the rural areas with similar pattern compared to urban populations. This phenomenon has become the rising trend of health problem in the developing countries (9-10).

Urbanization, western lifestyle, and lack of regular physical exercise significantly correlate with diabetes risk (11). An excess of lipid storage in adipose tissue is represented imbalance of energy intake to energy expenditure which is progress to overweight and obesity incidence (12). Therefore, other risk factors, including genetic disorder, unhealthy dietary patterns, and chronic inflammation are also contributing to the increasing of obesity-linked T2DM (13).

The improving of food safety against starvation and undernutrition is the part of the UN millennium development goal. The alternative therapy for combating malnutrition, obesity, and T2DM can be focused on the development of local resources. Hence, the exploration a reliable nutrigenomic therapy derived from novel local biodiversity has become a big challenge in the developing countries. *Moringaoleifera* is widely cultivated in the tropics and subtropical region, but mostly fast growth in equatorial region. Moringa is a common traditional medicinal plant rich in nutrition due to the presence of some essential nutrients in its leaves, seeds, and roots (3). *Moringaoleifera* was identified as the ideal health promoting food crop. Macronutrient concentrations of *Moringaoleifera* leaf powder vary among several areas and the comparison between local Indonesia *Moringaoleifera* remain not fully elucidated. Moringa is plant protein with *in vitro* and *in vivo* insulin-mimetic activity that mostly found in the leaves and seeds (14-15). Although previous studies have been done to explore the potential biochemical substances of Moringa leaf powder, however the basic characteristic of nutritional values within *Moringa oleifera* Sumenep Madura variety leaf powder is unknown.

2. METHODS

In this study, we were collecting Moringa leaf powder from two varieties of Sumenep Madura and Kupang East Nusa Tenggara respectively. Fresh leaf of two varieties from each area was harvested in the local farming area. The fresh leaves of *Moringaoleifera* were washed with clean water and placed on a vertical specific filter. Moringa leaf samples were dried at room temperature (25-27 ^{0} C) and low humidity for 4-5 days. For the next sample preparation, the dried leaf was collected and drilled into leaf powder by electrical homogenizer. The measurement of nutritional ingredients was conducted by using proximate analysis at laboratorium Sentral Ilmu Hayati, Brawijaya University and Balai Besar Laboratorium Kesehatan Surabaya, Indonesia.

3. RESULTS

According to proximate analysis results, our preliminary study improved that the nutritional ingredients within Moringa leaf powder from Madura variety is significantly different compared to our previous study, in particular Kupang variety. Our laboratory data showed that Moringa leaf powder from Sumenep Madura (**Table 1**) (variety A) has a higher level of protein (29.720 %), fat (4.971%), carbohydrate (38.417%), and vitamin C (985.305 mg/100g). Importantly, the similar pattern of nutritional ingredients was observed in variety B. The macronutrient concentration of this variety is 32.865 % of protein, 4.707% of fat, 36.784% of carbohydrate, and 1050.575 mg/100g of vitamin C. Therefore, no significant different between both varieties for macronutrient concentrations. Indeed, the higher level of vitamin C was observed in variety B compared to Variety A.

TABLE 1. The nutritional ingredients of Moringa leaf powder Madura variety

Parameter	Madura Variety	
	Variety A	**Variety B**
Protein (%/ 100g leaf powder)	29.720	32.865
Fat (%/ 100g leaf powder)	4.971	4.707
Carbohydrate (%/ 100g leaf powder)	38.417	36.784
Vitamin C (mg/100 g leaf powder)	985.305	1050.575

On the other hand, Kupang variety (**Table 2**) has a different profile which is the protein, fat, and carbohydrate levels. The level of those parameters is lower as compared with SumenepMadura variety. Therefore, the range level of protein, fat, and carbohydrate levels per 100 g dried leaf powder from Kupang variety is 23-27%, 1-2%, and 25-27% respectively. In addition, the level vitamin C of Kupang variety tends to have increased (data not shown) in the local very dry cultivated area. However, there is no a significant different for ascorbic acid concentrations compared to Madura variety.

TABLE2. The nutritional ingredients ofMoringa leaf powder Kupang variety

Parameter	Kupang Variety	
	Variety A	**Variety B**
Protein (%/ 100g leaf powder)	27.02	23.68
Fat (%/ 100g leaf powder)	1.97	1.04
Carbohydrate (%/ 100g leaf powder)	27.33	25.89

4. DISCUSSIONS

Our preliminary study was addressed to provide the basic nutritional characteristic of *Moringaoleifera* leaf powder from two different potential areas in Indonesia. We hypothesize that Moringa leaf powder Madura variety may provide some benefits for patients with malnutrition and overnutrition. Our laboratory examination data showed that Moringa leaf powder from Madura variety offer novel evidence as the potential nutrient sources from the local Indonesian biodiversity. The different levels of primary nutritional ingredients within leaf powder in both local plants were suggested associated with topography, local climate, land fertility, water supply, and soil mineral contents. In line with our hypothesis, optimal cultivation conditions, sulfur fertilization, and water availability were determined the biochemical changes within the leaf during the growing phase (24). Thus, the expanding of Madura varieties cultivation may provide the long term solution of food safety and nutritional supplementation for local population.

Importantly, in clinical studies, the basic problem for undernutrition is protein deficiency affect to the decreasing of immune response, body weight, and trigger metabolic perturbation. Several previous studies have shown that protein malnutrition corroborate pancreatic dysfunction through decreased size and secretory capacity of the pancreas in cholecystokinin null mice (16). Protein-energy malnutrition was also predicted associated with thermoregulatory homeostasis alteration and brain ischemia (17), while fetal protein malnutrition induced circadian disturbance before obesity progression (18). Moreover, protein intake deficiency was reported increased susceptibility to infections via down regulate homeostatic proliferation of CD8 T cell (19). Here, in our study, the higher level of protein portion within the dry leaf powder may secure the lack of protein intake in undernutrition subjects. It is suggested that Moringa leaf powder Madura variety is able to become nutri-immunomodulator and nutrigenomic alternative therapy for malnutrition. Linear to our hypothesis, Moringaoleifera leaves water extract attenuated inflammation (25). However, further laboratory and clinical investigation are recommended to clarify our speculation.

Interestingly, some important components within Moringa leaf have been associated with anti obesity and diabetes. In vivo studies have shown that isothyocianate from *Moringaoleifera* extract reduced body weight, insulin resistance, and liver gluconeogenesis (15, 20). The hypoglycemic activity of Moringa leaf supplementation was observed in T2DM patients during the 40-day period. Importantly, the plasma level of fasting glucose and post-prandial plasma glucose was significantly decreased after treatment (21). Furthermore, the Moringa leaf extract was able to reduce AGEs formation and may prevent AGEs linked DM complication (22). In addition, the Moringa leaf extract is not only reducing blood glucose levels, but also decreased lipid

concentration through inhibits pancreatic-amylase, pancreatic cholesterol esterase, and cholesterol micelle, improving the potential ability of Moringa as anti hyperlipidemia and hyperglycemia (23).A clinical study showed that 500 mg vitamin C twice a day was reduced hs-CRP, IL-6, and fasting blood glucose levels in hypertensive and diabetic obese patients (26). Here, our study showed anti obesity and inflammatory property of *Moringaoleifera* Madura variety leaf powder. The highest amount of ascorbic acid within our Moringa leaf powder may reduce the chronic inflammation, micro and macro vascular complication caused by obesity.

Based on our preliminary data, we suggest that Moringa leaf powder Madura variety has a similar activity to inhibit protein malnutrition in subjects with undernutrition status. Moreover, Moringa leaf powder Madura variety may be more potential to reduce metabolic disorder by enhancing glucose and lipid metabolism in the liver and peripheral tissues. Moringa leaf powder Madura variety treatment probably will attenuate obesity and T2DM progression through modulated fatty acid oxidation, glycolysis, reducing inflammation, and enhancing protein metabolism in patients with metabolic syndrome. However, the limitation of our study, we cannot provide complete information the basic role of Moringa leaf powder Madura variety in clinical application. Thus, further investigation is needed to elucidate our theory. In summary, Moringa leaf powder Madura variety might be proposed as an additional nutrigenomic therapy against malnutrition and metabolic diseases particularly obesity related T2DM in the younger population.