



## AMELIORATING EFFECT OF AVOCADO IN CARDIO-METABOLIC SYNDROME-A REVIEW

Silvia Navis<sup>1</sup>, Mkhoi L. Mkhoi<sup>1</sup> and Resal Raj<sup>2\*</sup>

<sup>1</sup>Department of Biomedical Sciences, School of Medicine and Dentistry, College of Health Sciences, The University of Dodoma, Dodoma, Tanzania.

<sup>2</sup>Department of Biotechnology and Bioinformatics, School of Biological Sciences, College of Natural and Mathematical Sciences, The University of Dodoma, Dodoma, Tanzania.

Article Received on 27/05/2016

Article Revised on 17/06/2016

Article Accepted on 07/07/2016

### \*Corresponding Author

**Dr. Resal Raj**

Department of  
Biotechnology and  
Bioinformatics, School of  
Biological Sciences,  
College of Natural and  
Mathematical Sciences,  
The University of  
Dodoma, Dodoma,  
Tanzania.

### ABSTRACT

According to the current scenario, the mortality rate is increased globally because of life style diseases, mainly cardiovascular complications rather than the communicable diseases. About 17.5 million people die each year because of cardiovascular disorders, an estimated 31% of all deaths worldwide. It is reported that diabetes is increasing in an alarming rate not only in the developed countries, but also in the world's middle-income countries. According to the current WHO estimation, more than 422 million adults are suffering from diabetes worldwide (WHO). Cardio-metabolic syndrome is

characterized by the co-occurrence of multiple metabolic disorders which include abdominal obesity, insulin resistance, hypertension, hyperglycemia and dyslipidemia. Cardio-metabolic complications are very common in children and adults all over the world because of fast changing lifestyle, over eating habits and the fast-food culture. Over weight, obesity, sedentary life style, and unhealthy dietary habits are the major risk factors for diabetes. Hence it is necessary to create awareness among the people to have healthy dietary habits which can get rid of cardio-metabolic syndrome and specifically the cardiovascular complications. Since the entire pharma industries are now moving towards phyto-constituents for the treatment of lifestyle disorders, this review may highlight the "Health benefits of Avocado in Cardio-metabolic syndrome" to know the nutritional effect of this wonder fruit as

a whole remedy for many disorders. Moreover, this review summarizes the research articles of animal and human studies that have proven the beneficial effects of avocado as a whole (Leaf, Fruit including seeds) in cardio-metabolic syndrome. Therefore, avocados can be incorporated into the diet and may be of additional benefit to those who have increased metabolic disease risk factors.

**KEYWORDS:** Ameliorating Effect, cardio-metabolic syndrome.

## INTRODUCTION

*Persea americana* (avocado), a tree belonging to the family, Lauraceae is used long time in traditional medicine for the treatment of ailments particularly stomach ache, bronchitis, diarrhea, diabetes and hypertension (Owolabi et al 2005). The cardio-protective effects of avocado have been widely demonstrated by Ojewole et al. (Ojewole et al 2007). The lipid-lowering (Kolawole et al 2012) as well as hypoglycemic effects (Edem 2009) of avocado are proven very well in animal models. Avocado is low in sugar and contains 15% Monounsaturated fatty acids (MUFA) rich oil, which helps to increase the absorption of carotenoids from salads often consumed with avocados (Unlu et al 2005).

### Nutritional value of Avocado

The “nutrient booster”, avocado gives very important nutrients which contain fiber (Dreher and Davenport 2012), minerals such as large amount of potassium, minor amount of Phosphorous, Magnesium, Copper, Manganese, Iron and Zinc, vitamins such as A, B complex (B1-Thiamine, B2-Riboflavin and B3-Niacin), C, E and K, folic acid, alpha and beta-carotene, Zeaxanthin and lutein, fats such as omega-3 fatty acids. Avocado is the fattiest plant food in existence and contains monounsaturated fatty acid as well as lipids such as phytosterols,  $\beta$ -sitosterol, campesterol, and stigmasterol. Its  $\beta$ -sitosterol lowers LDL levels and raises HDL levels. Avocado contains Glutathione, the natural antioxidant and increases antioxidant absorption from other foods. The carotenoids found in the pulp of avocado are chrysanthemaxanthin, neoxanthin, transneoxanthin and neochrome and form effective anti-inflammatory components of avocado.

### Beneficial effects in Cardio- Metabolic syndrome

Since avocado has varieties of minerals, vitamins and folic acids, it has endless beneficial effects. Tables 1 and 2 below show the beneficial effects of avocado in both animal and human studies.

**Table 1: Human studies on protective effects of Avocado in cardio-metabolic disorders.**

S. No	Parameter measured	Beneficial Effect	References
1.	Lipid levels	Lipid lowering effect	Peou et al 2016
2.	LDL level	Decreased LDL level	Wang et al 2015
3.	LDL level (Hypercholesterolemic patients)	Decreased LDL level	Carranza-Madrigal et al 1997
4.	HDL level	Increased HDL level	Carranza-Madrigal et al 1995
5.	Cholesterol	Cholesterol lowering effect	Colquhoun et al 1992
6.	Triglycerides (T2DM Patients)	Decreased TG level	Larman-Garber et al 1994
7.	Lowers metabolic syndrome	Increased HDL level	Fulgoni et al.2003

**Table 2: Animal studies on the protective effects of Avocado in cardio-metabolic disorders.**

S. No	Parameter measured	Animal Model	Beneficial Effect	References
1.	Blood Glucose levels	Alloxon induced diabetic rats	Reduced blood glucose	Sutrisna et al 2015
2.	Blood Glucose levels	Alloxon induced diabetic rats	Reduced blood glucose	Alhasson et al 2012
3.	Blood Glucose level, Oral glucose tolerance test (OGTT)	Alloxon induced diabetic rats	Reduced blood glucose	Ezejiofor et al 2013
4.	Blood Glucose levels	Alloxon induced diabetic rats	Reduced blood glucose	Edem et al 2009
5.	Body weight	High Fat Diet fed rats	Reduction in body weight	Brai et al 2007
6.	mRNA expression of adiponectin and PPAR- $\gamma$	High Fat Diet fed rats	Increased mRNA expression of adiponectin and PPAR- $\gamma$	Padmanabhan and Arumugam 2014
7.	Anti-oxidant level	STZ induced diabetic rats	Increased Antioxidants	Rao and Adinew 2011
9.	Blood Glucose levels	STZ induced diabetic rats	Reduced blood glucose	Lima et al 2012
10.	Blood pressure	Normotensive rats	Decreased B. P	Adeboye et al 1999
11.	Vasorelaxation	Isolated rat thoracic aorta	Relaxant effect	Owolabi et al 2005
12.	Lipid profile	Obese rats	Decreased lipid profile except HDL	Monika P and Geetha A 2015
13.	Blood Glucose levels	Alloxan Induced Diabetic Rats	Reduced blood glucose	Okonta and Okonta 2007

### 1. Cardiovascular disease

Cardiovascular disease is the most common cause of death in the world (Pieterse et al 2005). Individuals at risk of Cardiovascular diseases (CVD) may have increased blood pressure, glucose, and lipids as well as overweight and obesity. When mono and polyunsaturated fats

are consumed in moderation in place of saturated or trans fats, there is reduction of blood cholesterol levels and decreased risk for heart diseases. Avocados are one of the few fruits that provide "good" fats. Studies by Fulgoni et al. showed that avocado consumption is associated with reduced metabolic syndrome (Fulgoni et al 2013). Since it contains monounsaturated fatty acids mainly Oleic acid, it reduces the risk of cardiovascular diseases. It also contains folic acid which controls homocysteine level. Oleic acid, a heart healthy fatty acid and folic acid, both together reduces the inflammation in heart. Since several studies show that high potassium intake is linked with reduced blood pressure which is a major risk factor for heart attacks, strokes and kidney failure (USDA, 2011), taking avocado may substitute the requirement of potassium. The various ways by which avocado decrease CVD are: reduce total cholesterol levels, blood triglycerides, LDL cholesterol, and Increase HDL levels (Brai et al., 2007). Studies by Wang et al. showed that avocado in a low-fat vegetarian daily diet may lead to improvement in the cholesterol profile (Wang et al 2015).

## **2. Blood Pressure**

Increased Blood pressure is one of the major contributor of cardiometabolic syndrome. Avocado has rich potassium (345mg) and low sodium (140mg) content to maintain the normal blood pressure (Fulgoni et al 2013). Moreover, avocado is rich in antioxidant and vitamins (vitamin C, E) it decreases blood pressure. The consumption of Avocado leaf extract decreased the total cholesterol and blood pressure in hypertensive patients and in animal studies, aqueous and methanolic leaf extract produced dose dependent decrease in blood pressure (Adeboye et al 1999). Aqueous extract of avocado produced dose dependent relaxation effect in rat aorta which is pre-constricted with noradrenaline. This shows the Vasorelaxant Property of Avocado. The same effect may also be produced by the prevention of  $Ca^{2+}$  mobilization through voltage-dependent channels that to a lesser extent, through receptor-operated channels (Owolabi et al 2005) and also by the synthesis and release of endothelium-derived relaxing factors (EDRFs) which is nitric oxide, NO.

## **3. Diabetes**

It is reported that diabetes is increasing in an alarming rate not only in the developed countries, but also in the world's middle-income countries. According to the current WHO estimation more than 422 million adults are suffering from diabetes worldwide and more than 2.2million deaths occur per annum because of diabetes associated cardiovascular diseases. Various animal studies proved the hypoglycemic effect of avocado (Sutrisna et al 2015,

Alhassan et al 2012, Edem et al 2009, Lima 2012, Okonta et al 2007). Studies using Alloxan induced diabetic rats by Ezejiofor et al showed that the extract of Avocado seeds are useful in the management of diabetes (Ezejiofor et al 2013). Administration of aqueous extract of Avocado seed contributes significantly to the reduction of blood glucose levels and can be useful in the treatment of diabetes (Edem et al 2009). The hydroalcoholic extract of Avocado leaves reduced blood glucose levels and improved the metabolic state of the animals (Lima et al 2012, Antia et al., 2005). Administration of hydroalcoholic extract of Avocado in HFD fed rats have decreased the body mass index (BMI), total fat pad mass and the adiposity index. The mechanism of the beneficial effect of avocado is proved by the increased mRNA expression of adiponectin and PPAR- $\gamma$  in liver, heart and adipose tissues of Avocado treated rats as compared to the control rats (Padmanabhan and Arumugam 2014).

#### **4. Weight reduction**

Avocado contributes around 8% of daily fiber intake which can cause a tremendous weight loss (Dreher et al 2012). After eating a meal with avocado, it is felt 23% more satisfied and have lower desire for further eating (Pieterse et al 2005). Studies by Fulgoni et al showed that there is a significant decrease in body weight, BMI, and waist circumference (WC) in people who consume avocado (Fulgoni et al 2013). It is because avocados contain a spectacular seven carbon sugar, D-manno-heptulose that does not contribute to energy production and it may support blood glucose control ultimately the weight management by reducing glycolysis through hexokinase Inhibition. Adding avocado as diet may assist the postprandial dysfunction in glucose homeostasis, which may be present in overweighting individuals. The administration of aqueous and methanolic leaf extracts of the avocado caused a reduction in body weight compared with the hyperlipidemic controls (Brail et al 2007). This could be due to the reason that the leaf extracts may increase the catabolism of lipids which accumulated in the adipose tissue resulting in a decrease in the mean body weight (Brai et al 2007, Pieterse et al 2005). The hypolipidemic effect of hydro-alcoholic fruit extract of avocado (HFEA) is due to its modulation on endogenous fat molecule synthesis and formation of adiponectin through transcription factor, FGF21. The avocado fruit extract influences leptin activity, which controls satiety and hunger to regulate the food intake (Monika and Geetha 2015). Avocado contains Phytosterols to compete with cholesterol for micelle formation in the intestinal lumen and inhibit cholesterol absorption. Anti-obesity effects have also been reported in both leaves and fruits of Avocado (Brai et al. (2007). It was reported that the treatment with aqueous and methanolic extracts of leaves of Avocado (10 mg/Kg) for 8 weeks to

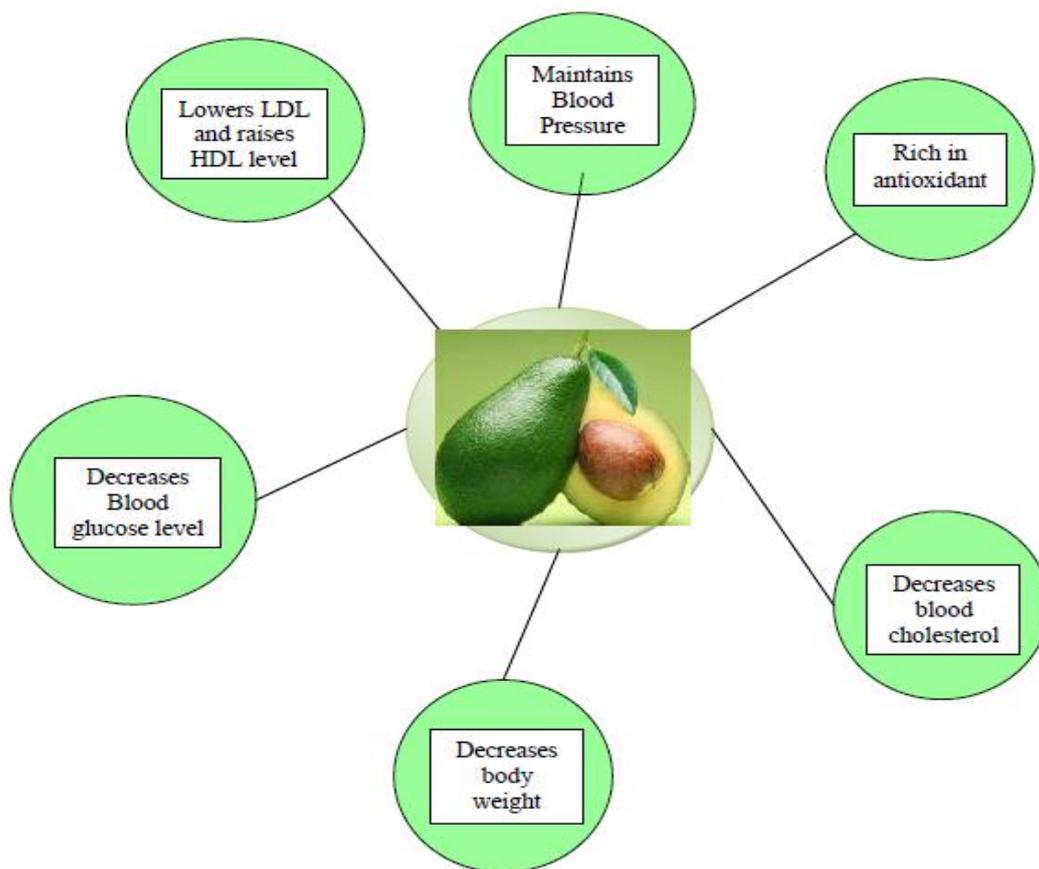
hypercholesterolemic albino rats caused 25 % reduction in the body weight gain as compared to the control (Pieterse et al 2005, Padmanabhan and Arumugam,2014). Same results are reported by Naveh et al 2007 after using avocado pulp in hypercholesterolemic rats (Naveh et al 2007). The avocado seed oil has several health benefit one being the control of human weight and especially used for obese to get weight loss (Lopez et al., 1996).

### **5. Dyslipidemia**

According to American Medical Association (AMA) dyslipidemia is an increase of serum lipids and lipoproteins including decrease of HDL-cholesterol that is associated with increased coronary heart diseases (CHD) risk. Avocado is rich in monounsaturated fatty acids is used in the treatment of hypercholesterolemia (Lopez et al 1996, Carranza et al 1995) and hyperlipidemia (Munoz 1992). Human studies have shown that the intake of avocado by dyslipidemia patients has decreased the serum TG levels and increased HDL levels compared with baseline. Previous findings shown that a diet supplemented with avocado oil to diabetic subjects having dyslipidemia has decreased TG levels (Lerman-Garber et al. 1994, Carranza et al. 1997, L'opez Ledesma et al 1996). Similarly, the observations of the above study add support to many studies. This indicate that oils rich in monounsaturated fatty acids and micronutrients may help lower TG levels and reduce the complications in the lipid profile observed with saturated fatty acids. This is because HDL-Cholesterol has been significantly ( $p < 0.01$ ) higher in avocado consumers compared to consumers who do not add avocado as diet. The odds ratio for metabolic syndrome has been 50% lower in those who ate avocados compared to those who did not (Fulgoni et al 2013). Avocado oil can be very well used in the treatment of metabolic syndrome as it reduces TG, LDL and VLDL levels (Peou et al 2016).

### **6. Antioxidant property**

Avocado is rich in glutathione and vitamin E which are natural antioxidants. The methanolic leaf extract of avocado is hepato-protective and can be used in the treatment of various diseases involving oxidative stress (Kawagishi et al 2001). Studies by Kim et al. has shown the presence of the compounds persenone A and B which is responsible for the antioxidant property of avocado (Kim et al 2000). The phenolic content of seeds of avocado pear was found to be greater than 70% which is responsible for its antioxidant activity. (Soong and Barlow, 2004). The highly functionalized alkanols of avocado have exhibited quite diverse biological properties (Yasir et al., 2010). Figure 1 shows the health benefits of avocado.



**Figure 1: Health Benefits of Avocado in Cardio metabolic Disorder.**

## CONCLUSION

It is clear that the major risk factors for cardio metabolic syndrome are due to increase in total cholesterol, hyperglycemia, systolic blood pressure, decrease in HDL, Obesity etc. and diet is the controller of all such disorders. Since Avocado has been proved for its health benefits in the above said risk factors, it is good to follow healthy life style by having healthy foods. Dietitians can recommend consumption of avocados as part of a healthy diet that focuses on increased fruit and vegetable intake. Avocados can be incorporated into the diets and may be of additional benefit to those who have increased metabolic disease risk factors.

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