EVALUATION OF HYPOLIPIDEMIC EFFECT OF SOME COMMON FOODS IN EGYPT

By

KAREM EL-SAYED ALY FOUDA
B.Sc. Agric. Sci. (Biotechnology), Fac. Agric., Cairo Univ., 2003

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Title of Thesis: Evaluation of Hypolipidemic Effect of Some Common Foods in Egypt.
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ABSTRACT

The present study was designed to evaluate the hypolipidemic effect of some common foods in Egypt, such as some vegetables (onion, tomato, parsley, red beetroot, head of cabbage, head of lettuce, head of radish and green pepper fruits), some cereals (whole and peeled wheat) and some legumes (chickpea, lupine and fenugreek seeds) which were analyzed then two powdered mixtures were prepared from these samples. The first mixture was prepared from whole wheat, cabbage, parsley and pepper, but the second one was prepared from whole wheat, red beet root, parsley and pepper. Chemical composition of these mixtures was analyzed. The hypolipidemic effect of these two mixtures was evaluated in hyperlipidemic rats fed on balanced diet containing either mixture (1) or (2) for four weeks. The nutritional safety of these mixtures was evaluated through liver and kidney functions. Chemical composition of the powder mixtures revealed that mixture (1) contains protein, crude fibers, ash, dietary fibers, vitamin E, β-carotene, total phenolic compounds and saponin more than mixture (2), while mixture (2) contains fat and carbohydrates more than mixture (1). Results of animal experiment showed non-significant changes in final body weight and body weight gain in rats fed on balanced diet containing mixture (1) or (2) when compared with health control rats. Hyperlipidemic rats fed on balanced diet containing mixture (1) or (2) showed significant reduction in plasma total lipids, total cholesterol, low density lipoprotein cholesterol (LDL-C), triglycerides and the ratio of total cholesterol/ high density lipoprotein cholesterol (HDL-C) with different degrees, while HDL-C was increased significantly in hyperlipidemic rats. Plasma levels of creatinine and urea as indicators for kidneys function showed non-significant changes in all groups relative to control. Also plasma activities of AST and ALT, as indicators for liver function, showed non-significant changes in all studied groups relative to control. These results revealed that there was a complete safety of the present studied mixtures for feeding.

Key words: Hyperlipidemia, vegetables, cereals, legumes, dietary mixtures.

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INTRODUCTION

Cholesterol is essential for many functions in the human body. However, imbalance of cholesterol level as a result of environmental and genetic factors leads to hyperlipidemia, a predominant risk factor for cardiovascular diseases (CVD) (Deng, 2009). CVD including coronary heart disease and stroke are the leading cause of mortality in both developed and developing countries, accounting for roughly 20% of all worldwide death pear year (Thomas and Rich, 2007). Therefore, hyperlipidemia and its associated CVD represented one of the greatest worldwide economic, social and medical challenges that we are facing now (Olshansky *et al*., 2005).

Diets play a crucial role in the etiology of CVD (Ness and Powles, 1997a). Changes in dietary patterns such as reduced cholesterol intake, restriction of carbohydrate and fat intake as well as substitution of polyunsaturated for saturated fats may be the most obvious means by which levels of plasma lipids could be controlled (Lichtenstein, 2006).

Consumption of fruits, vegetables and cereals is associated with a lowered risk of CVD (Prior, 2003 and Nicolle *et al*., 2004). This beneficial effect has been ascribed, in part to the antioxidants, vitamin C, polyphenols, vitamin E and carotenoids in plant-based foods. Vegetables, cereals and other plant foods rich in antioxidant molecules have received a growing interest because they delay oxidative degradation of lipids and thereby improve the nutritional value of food (Nicolle *et al*., 2004). Also vegetables and cereals are rich sources of dietary fibers, which reduced blood total cholesterol and low density

lipoprotein cholesterol (LDL-C) (Olmo *et al*., 2007). In recent years, many studies have focused on the bioavailability of phenolic compounds in the prevention and treatment of hyperlipidemia and obesity. Phenolic compounds and flavonoids have pharmacological properties such as antioxidant, antithrombotic, anti-cancer and hypolipidemic (Monfort *et al*., 1995 and Son and Lewis, 2002). They are widely distributed in plants and form part of the human diet.

Therefore, the aim of the present work was to achieve the followings:

1. Since the chemical composition of crops varies with crop cultivars, soil and climatic conditions of the area, it is important to study the chemical composition of some vegetables, cereals and legumes grown in Egypt before using any of them in the study.
2. Determination of dietary fiber and some phytochemicals such as total phenolic compounds content and saponins in all the studied plants.
3. Preparation of two plant mixtures from cereals and vegetables and studying their chemical composition and its content from dietary fiber, total phenolic compounds, saponin, β-carotene and vitamin E.
4. Evaluation of the hypolipidemic effect of the prepared plant mixtures in hyperlipidemic rats.

REVIEW OF LITERATURE

1. Interrelationship between blood lipids and cardiovascular diseases.

Cholesterol is a multifunctional molecule, which serves as an essential membrane component, as a regulation cofactor for receptors and as a precursor for steroid hormones. All biological membranes are composed of lipids and proteins. The most abundant lipids in the plasma membrane of mammals are phospholipids and cholesterol. Forming the basis of the membrane, the phospholipids are arranged in a bilayer structure that creates a selective barrier for polar molecules. Cholesterol is obtained from the diet and can also be synthesized in the liver. The average North-American diet provides about 300–500 mg of cholesterol per day, while endogenous supplies of cholesterol can reach 1000–1600 mg per day. The rate of cholesterol formation by the body is highly responsive to the amount of cholesterol absorbed from dietary sources. It has been shown that a reduction of cholesterol absorption in the gut could not only reduce total serum cholesterol level, but could also increase the ratio of high density lipoprotein cholesterol (HDL-C) to low density lipoprotein cholesterol (LDL-C) in blood (Rozner and Garti, 2006).

Maintenance of cholesterol homeostasis is vital for healthy status and achieved through a regulatory network consisting of genes involved in cholesterol synthesis, absorption, metabolism and elimination. Imbalance of cholesterol level leads to hyperlipidemia, a predominant risk factor for cardiovascular diseases (CVD) (Ballantyne

et al., 2005). Hyperlipidemia is an elevation of lipids (fats) in the bloodstream and usually means high level of total cholesterol (TC), triglycerides (TG) and low-density lipoprotein cholesterol (LDL-C) along with decrease in high-density lipoprotein cholesterol (HDL-C) (Harrison *et al*., 2003). Cardiovascular diseases including coronary heart disease and stroke are the leading cause of mortality, accounting for nearly 50% of all deaths in the Western developed world (Rich, 2006). CVD risk increases proportionally with cholesterol levels (Sacks, 1998). Total cholesterol and LDL-C levels predict both first and recurrent coronary events (Rose *et al*., 1997). HDL-C has an inverse relation with coronary artery disease risk, with low levels predicting increased risk (Rifkind, 1990). The ratio of total to HDL-C represents a summary lipid measure of coronary artery disease risk, which begins to increase when the ratio exceeds 5 (Kinosian *et al*., 1994).

Several ecological and epidemiological studies have proved that elevated plasma levels of total cholesterol and, in particular, LDL-C are associated with an increased risk of coronary and, in general, cardiovascular events (Grundy, 1990). High level of LDL-C deposits on the interior of blood vessels resulting hardened arteries, narrowing of the blood vessels and coronary heart disease. High levels of HDL-C have been shown to reduce some of the harmful effects of LDL-C. HDL-C picks up and transports cholesterol in the blood back to the liver, which leads to its elimination from the body. HDL-C can help to keep LDL-C from building up in the walls of the arteries (Lichtenstein, 1998).

The large majority of epidemiological studies have also demonstrated that elevated plasma triacylglycerol (triglyceride) and/or reduced plasma HDL-C concentrations are associated with increased cardiovascular risk (Poli *et al*., 2008). During the past decade, a great deal of interest has focused on the effect of lipoprotein lipase (LPL) on lipid metabolism and atherogenesis. LPL is produced mainly by the adipose, heart, and muscle tissues and to some extent by macrophages. It plays an important role in lipid metabolism by hydrolyzing core triglycerides (TG) from circulating chylomicrons and very low-density lipoproteins (VLDL-C) (Beisiegel, 1996). Decreased LPL activity leads to increased TG and decreased HDL-C levels, which are risk factors for the development of atherosclerosis (Patsch *et al*., 1987 and Kuusi *et al*., 1989).

More recently, many controlled studies undertaken with dietary intervention have demonstrated that reduced plasma levels of total and LDL-C result in a decreased incidence of such events. The risk reduction is strongly related to the magnitude of the decline in LDL-C. In general, a 1% decrease in plasma levels of total or LDL-C is followed, on average, by a 1% risk-reduction (Lichtenstein, 2006).

2. Relationship between food component and blood lipid profile

Diet plays a crucial role in the etiology of cardiovascular diseases (Pittaway *et al*., 2008). The classic diet-heart hypothesis postulates that an increased intake of saturated fats and cholesterol and a reduced intake of polyunsaturated fats increases blood cholesterol levels, which