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Astashine Capsules: An Excellent Choice as Kidney Protector & as Anti-Diabetic

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ABSTRACT

Globally, Diabetes Mellitus and its complications is the third largest killer. At the current rate, the diabetic population of 171 million will increase to 366 million by 2030. One of the most common complications associated with DM is nephropathy or kidney damage. Diabetes is strongly linked to oxidative stress as either a consequence of increased ROS production, reduced antioxidant status, or both. Oxidative stress in diabetes is brought on by consistent hyperglycemia (high blood sugar levels) from a very high carbohydrate diet, reduced cell carbohydrate uptake, and/or low insulin output from the pancreas. Astaxanthin could lessen oxidative stress in pancreatic beta cells (the cells in body that produce insulin) caused by chronic high blood sugar levels. In turn, this improves the body's ability to manage blood glucose levels by allowing the pancreatic cells to make the right amount of insulin when needed. Astaxanthin was found to improve pancreatic beta cell function and protect these cells from glucose toxicity, cell breakdown and death. This article reviews the current available scientific literature regarding the effect of astaxanthin from the algae Haematoccus pluvialis as Antidiabetic and kidney protector.

Introduction

The study shows that the antioxidant power of astaxanthin, which reportedly is 500 times stronger than that of vitamin E, can protect cells against the oxidative damage caused by high glucose (sugar) levels. High blood sugar levels and oxidative stress are associated with complications common among diabetics, including kidney disease, neuropathy (nerve damage), and diabetic retinopathy (vision problems).

In a Clinical study cells treated with high levels of glucose, and then exposed to astaxanthin. It is found that astaxanthin suppressed activities that damage cells and lead to complications associated with diabetes. Astaxanthin was also able to hinder lipid peroxidation (damage to fats in cell membranes by free radicals) and levels of total reactive species, superoxide, and nitric oxide (molecules that cause extensive cell damage).

Thus it conclude that the strong antioxidant properties of astaxanthin that allow it to reduce oxidative stress, inflammation, and cell death are the reasons why it could be an effective supplement to help prevent complications associated with elevated glucose levels in diabetics.

Composition of Astashine capsules

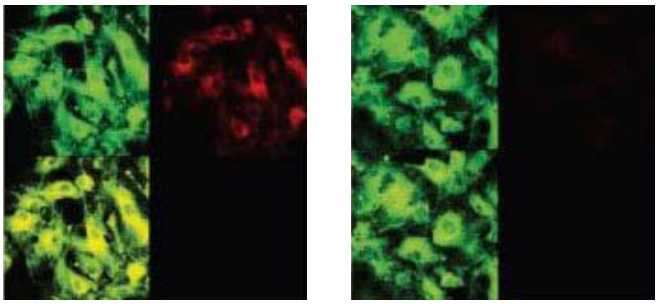
Astaxanthin – 2 mg

(Naturally derived from Haematococcus pulvialis algae extract, which is microencapsulated)

Clinical Study Reports of Astashine Capsules

Scientists from the Kyoto Prefectural University of Medicine, Japan confirmed that astaxanthin significantly suppressed ROS production, biomarkers of oxidative damage and proinflammatory responses in mitochondria of Normal Human Mesangial Cells (NHMC) exposed to high-levels of glucose. Manabe *et al*., (2007) exposed NHMC to 25 mM D-glucose (equivalent to 400 mg/dl in humans) to investigate the oxidative damage reported in diabetic nephropathy or kidney damage (Fig.1). Chronic high-blood-glucose levels

increase Reactive Oxygen Stress (ROS) production in mitochondria. ROS affects not only on the development of diabetes but also on its complications such as mesangial cell damage which leads to loss of kidney function. Since the progress of kidney damage is mostly irreversible and has an extremely poor prognosis, it is important to prevent the onset and progression of the nephropathy in the early stage of Diabetes Mellitus (DM) Type 2 [1].



(a) (b)

Fig.1. Astaxanthin reduced high-glucose-induced mitochondria-dependant ROS production in NHMCs: (a) Control 25 mM D-Glucose, (b) Astaxanthin + 25 mM D-Glucose

The scientists from Kyoto Prefectural University of Medicine, Japan suggested using astaxanthin, a powerful antioxidant, to scavenge ROS in the prevention of diabetic nephropathy.

Furthermore, an oxidative lipid peroxidation marker, 4-hydroxy-2,3-nonenal (4HNE), was significantly reduced ($P<0.05$) by 50% with astaxanthin (Fig.2). Astaxanthin was also confirmed to localize in the cell mitochondrial membrane of NHMC by quantitative analysis [2].

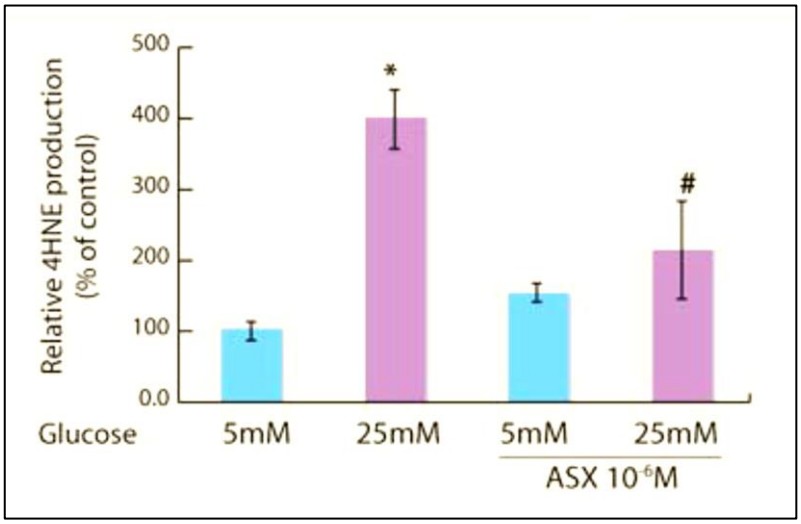
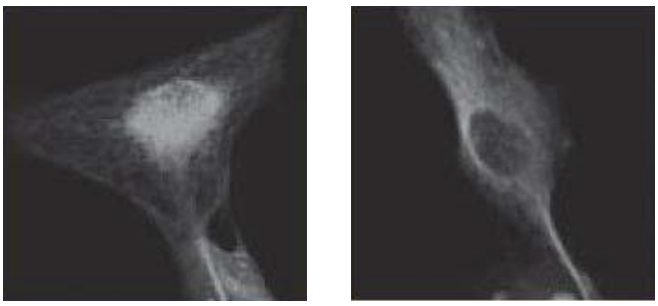


Fig.2. Astaxanthin inhibited high-glucose induced production of 4-HNE oxidative stress-modified proteins in mitochondria of NHMCs

NHMCs pre-incubated with astaxanthin reduced the inflammatory response. For example, NF-kB activation and subsequent movement to the cell nucleus for inflammatory gene activation was inhibited (Fig.3). Astaxanthin also reduced AP-1activation and expression/production of COX-2, MCP-1, and TGFB1. If not suppressed, these factors will promote the pathogenesis and mesangial cell injury. Although the mechanism

by which astaxanthin suppresses ROS is that astaxanthin may affect part of the electron transport chain and protect mitochondria from the detrimental effects of glucose toxicity.

In summary, astaxanthin may scavenge excess ROS, reduce ROS-protein damage, and inhibit inflammatory process. Therefore, the onset of nephropathy may expect to be prevented or delayed [3]. In a separate study, randomized glycemic control reduced or normalized mitochondrial ROS production and delayed the onset and progression of early stage diabetic complications. Further, studies showed that astaxanthin reduced kidney damage in diabetic mouse models and many other biomarkers (reduced DNA damage, improved glucose-tolerance test, lowered NFkB). Studies demonstrated that astaxanthin could suppress ROS and reduce nephropathy [4].



(a) (b)

Fig.3. Astaxanthin suppressed high-glucose induced nuclear translocation/activation of NF-kB: (a) in 25 mM D-Glucose, (b) in 25 mM D-Glucose and Astaxanthin

Mechanism of Action of Astashine capsules in Type 2 Diabetes

In most cases, diabetes is treated with medication, although about 20% of diabetes may be managed by lifestyle changes. This means that even if we cannot change the genetic influences, fortunately, for most of us diabetes is preventable; for example, making dietary changes, taking nutritional supplements and exercising. To highlight this, people in high risk groups who achieve a 5-7% cut in body weight will reduce risk of developing diabetes approximately 58% across all age and ethnic groups. Research reveals a strong link between foods with high glycemic index and prevalence of type 2 diabetes. Excess blood glucose needs to be converted by insulin (produced by the pancreas ß-cells) into glycogen stores, however, when glycogen stores are full, glucose is converted into fat. Over time, the body's cells may eventually become desensitized to insulin. Astaxanthin displayed positive effects in a type-2 diabetes by reducing the disease progression by retarding glucose toxicity and kidney damage. This has profound implications for people who belong to high risk groups, display pre-diabetic conditions (impaired fasting glucose or impaired glucose tolerance) or want to manage advanced diabetic kidney problems (nephropathy).

Studies suggested that reactive oxygen species (ROS) induced by hyperglycemia contributes to the onset of Diabetes mellitus and its complications. Non-enzymatic glycosylation of proteins and mitochondria, prevalent in diabetic conditions, is a major source of ROS. For example, pancreatic ß-cells kept in high glucose concentrations show presence of advanced glycosylation products, a source of ROS, which cause the following: i) reduction of insulin expression and ii) induction of cell death (apoptosis).ß–cells are especially

vulnerable to ROS because these cells are inherently low in antioxidant status and therefore, requires long-term protection. A recent study demonstrated that antioxidant Astaxanthin exerted beneficial effects in diabetic conditions such as preservation of ß-cell function.

Uchiyama *et al*., 2002 demonstrated in obese diabetes type 2mouse model that astaxanthin preserved pancreatic ß–cell dysfunction against oxidative damage. Treated mice received 1mg astaxanthin/day at 6 weeks of age and then tests performed at 6, 12 and 18 weeks. Observations of astaxanthin treated mice.

(N=8) included: i) significantly reduced fasting glucose sugar levels at 12 ($P<0.01$) and 18 weeks ($P<0.01$); and ii) decreased glucose ($P<0.001$) and insulin ($P<0.001$) levels in the blood serum. In additional, treated rats displayed better response profiles to the intra-peritoneal glucose tolerance test (IPGTT at 1gglucose/kg bodyweight. This showed that astaxanthin preserved pancreas function and insulin sensitivity. Furthermore, preliminary renal damage assessment measuring urinary albumin levels revealed significantly lower glomerular (kidney) damage. This was confirmed in another study by Naito *et al*., 2004, who looked at diabetic nephropathy in the type 2diabetic mouse model. Astaxanthin can also circumvent high glucose toxicity which normally leads to increased oxidative stress and pathogenesis of kidney damage.

Naito demonstrated that astaxanthin treated type 2 diabetic mice which normally shows renal insufficiency at 16 weeks of age infact exhibited 67% less urinary albumin loss ($N=5$, $P<0.05$) and figure 4 shows 50% less DNA damage (8-OHdG, $P<0.05$).Furthermore, the increased protein loss was due to the vascular size ratio increase of 250% in the diabetic model. In astaxanthin treated mice, this area was significantly ($P<0.05$) reduced by almost 54% .

Naito *et al*., (2006) examined changes in the gene expression profile of glomerular cells in diabetic mouse model during the early phase of diabetic nephropathy. The mitochondrial oxidative phosphorylation pathway was most significantly affected by high-glucose concentration (mediated via reactive oxygen species). Long term treatment with astaxanthin significantly modulated genes associated with oxidative phosphorylation, oxidative stress and the TGF-s-collagen synthesis system.

Astaxanthin and Type 2 Diabetes

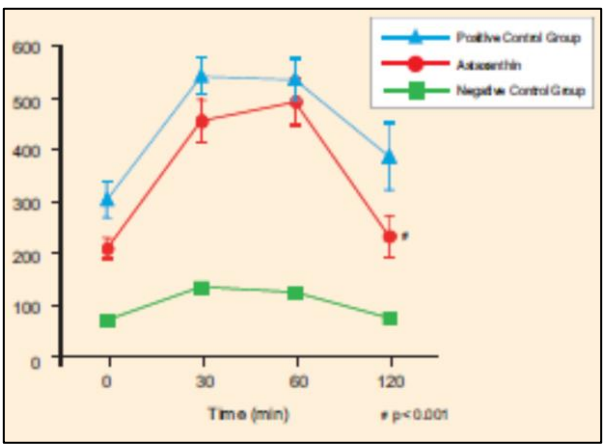


Fig.4. Astaxanthin improved the glucose levels in the Intraperitoneally Glucose Tolerance Test (IPGT) in diabetic mouse model (Uchiyama *et al*., 2002)

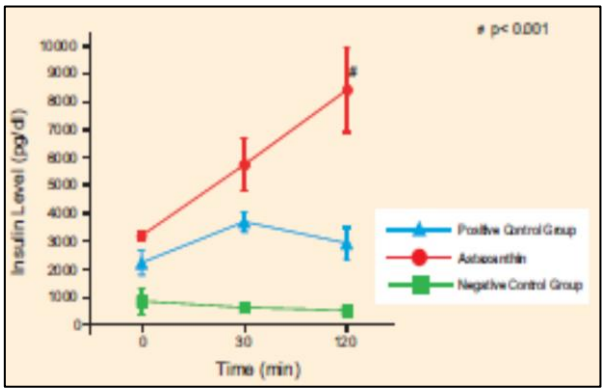


Fig.5. Astaxanthin preserved insulin sensitivity in the diabetic mouse model (Uchiyama *et al*., 2002)

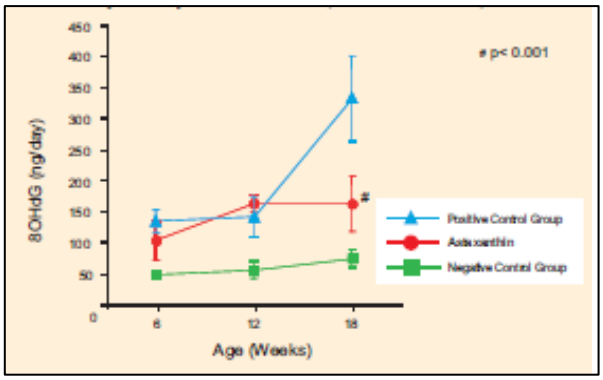


Fig.6. Astaxanthin protected kidney function measured by urinary albumin protein loss (Naito *et al*., 2004)

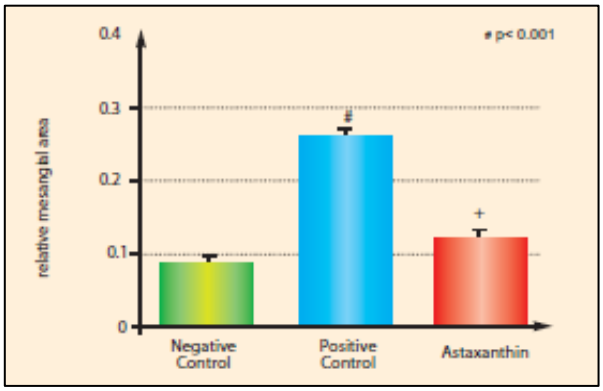


Fig.7. Astaxanthin preserved the relative mesangial area +p<0.05 vs positive control (Naito *et al*., 2004)

Safety of Astashine Capsules

Astaxanthin has demonstrated safety in numerous human clinical trials. In one open-label clinical study on subjects with metabolic syndrome (n=17). Astaxanthin (16 mg/day, for three months) significantly raised blood bilirubin ($p \leq 0.05$), potassium ($p \leq 0.05$), and creatine kinase ($p \leq 0.01$), although all three values remained within normal range. Also, astaxanthin significantly lowered the liver enzyme gamma-glutamyl transpeptidase (GGTP; $p \leq 0.05$). Since the researchers noted this enzyme was abnormally elevated in 11 of the 17 subjects at baseline, this astaxanthin effect may have been beneficial. Animal experiments have investigated astaxanthin at levels well over 120 mg/day in human equivalents, without causing apparent harm. Hoffman-La Roche confirmed its safety with extensive tests, including acute toxicity, mutagenicity, teratogenicity, embryotoxicity, and reproductive toxicity.

Suggested Dosage

The doses of astaxanthin used in clinical trials have ranged from 1 mg/day to 40 mg/day (with the majority in the 6-12 mg range); single-dose pharmacokinetic studies used up to 100 mg per dose. As a dietary supplement, astaxanthin should be taken along with fats, with or immediately prior to meals, to ensure its optimal absorption.

Summary & Conclusion

Clinical studies shows that the antioxidant power of astaxanthin, which reportedly is 500 times stronger than that of vitamin E, can protect cells against the oxidative damage caused by high glucose (sugar) levels. High blood sugar levels and oxidative stress are associated with complications common among diabetics, including kidney disease, neuropathy (nerve damage), and diabetic retinopathy (vision problems).

Astaxanthin suppresses activities that damage cells and lead to complications associated with diabetes. Astaxanthin was able to hinder lipid peroxidation (damage to fats in cell membranes by free radicals) and levels of total reactive species, superoxide, and nitric oxide (molecules that cause extensive cell damage).

The strong antioxidant properties of astaxanthin that allow it to reduce oxidative stress, inflammation, and cell death are the reasons why it could be an effective supplement to help prevent complications associated with elevated glucose levels in diabetics and to further benefit people at risk of diabetic complications such as diabetic kidney disease.

Declarations

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This research did not receive any grant from funding agencies in the public or not-for-profit sectors.

Competing Interests Statement

The authors declare no competing financial, professional and personal interests.

Consent for publication

Authors declare that they consented for the publication of this research work.

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