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Basic nutritional investigation

Structural and functional abnormalities of hepatic tissues in male Wistar rats fed hyperwhey and super amino anabolic protein

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ABSTRACT

Objective: Athletes and bodybuilders consume high-protein supplements to obtain energy and enhance the development and strength of their muscles. Over time, different investigations have revealed dysfunctions of their body organs. There are contradictions among scientists concerning the benefits and the alarm of developing body dysfunction. The aim of this study was to illustrate the effects on consumption of two anabolic protein supplements on body weight and structure and function of hepatocytes in male albino Wistar rats.

Methods: We assigned male Wistar albino rats into three groups (n = 10 each): control, hyperwhey protein (Nutrabolics, Richmond, Canada) (2.5 g/kg body weight), and super amino 2500 (SA) (APN, Ft. Launderale, FL, USA) (2.5 g/kg body weight). The applied dose was orally administered daily in tap water for 14 wk. Body weight was regularly measured. At 14 wk, animals were sacrificed and dissected. Blood was collected from a puncture of the heart and the liver was removed and weighed. Biochemical analysis of liver function tests, lipidogram, hematology, histopathology, transmission electron microscopy, immunohistochemistry of proliferating cell nuclear antigen, B-cell lymphoma 2 and 70 kd heat shock proteins, and flow-cytometry of hepatocyte cell cycle were performed.

Results: Hyperwhey- and SA-supplemented rats had lower body weight gain compared with the control group and developed hepatic dysfunction manifested by apparent congestion of blood vessel, increased apoptosis, and breakdown of hepatocytes. The SA group had thickening of the liver capsule and more drastic damage of hepatocytes. The level of transaminases was markedly increased. Insulin level was also markedly decreased in parallel with increase cholesterol, low-density lipoprotein, and triacylglycerols.

Conclusion: Hyperwhey and SA protein formula administration dramatically altered the liver function and increased hepatic damage similar to the development of suspected diabetes.

Introduction

Most athletes and bodybuilders use protein supplements to enhance the development and strength of their muscles and to accelerate the release of growth hormone [1]. Casein, whey, and soy proteins are the most popular protein supplements, having a high caloric value and being effective for increasing muscle mass [2]. Whey protein contains total cow's milk protein (~20%), lactoglobulin (50%), B-lactalbumin (25%), serum albumin (7%), and immunoglobulins (5%). Due to its high concentrations of amino acids, it plays a significant role in protein synthesis and carbohydrate metabolism and provides energy requirements during exercise [3]. Although some studies have found that consumption of whey protein supplementation induces adverse kidney damage, hepatic damage, or both [4], other human studies have demonstrated that higher protein intakes exerted

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Table 1
Nutrient contents of hyperwhey*

Item	% (per 100 g)
Total fat	5.7
Cholesterol	0.3
Total carbohydrate	14
Dietary fiber	4
Sugar	5.7
Protein	68
Sodium	1
Potassium	0.3
Calcium	0.4
Iron	0.3

* Other ingredients are included such as cocoa powder, taurine, nondairy creamer (sunflower oil, corn syrup solids, dipotassium phosphate, sodium caseinate, sodium silico aluminate), soy lecithin, mono- and diglycerides, natural and artificial flavors, maltodextrin, L-glycine, L-leucine, L-isoleucine, L-glutamine, L-valine, caragreenan gum, xanthan gum, sucralose, acesulfame potassium, salt, lactase enzyme. The average percentages of amino acids are not included by the manufacturer.

no adverse effects on renal or liver function markers [5,6]. Excessive protein intake may lead to dehydration, gout, liver and kidney damage, calcium loss, and gastrointestinal disturbances [7]. Feeding a high-casein diet led to a marked increase of urinary calcium phosphate and increased bone resorption in rats [8,9]. Also, consumption of high-protein diets was found to cause a considerable increase in kidney weight, urinary volume, and acidity, as well as in the urinary excretion of calcium, with a parallel reduction in the urinary excretion of citrate leading to alterations in renal health status in pigs [10] and rats [11]. Feeding mice with a 50% casein diet led to a marked increase in serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) activities; liver Finkel-Biskis-Jinkins osteosarcoma oncogene; and nuclear receptor subfamily 4, group A, member 1 mRNA levels [12]. High-protein/high-meat intake in humans was associated with the development of disorders such as bone and calcium homeostasis, renal dysfunction, increased cancer risk, liver dysfunction, and progression of coronary artery disease [4].

To our knowledge, there is no available work concerning these anabolic protein supplements and liver disease. The present study aimed to illustrate the effects on the body weight and structure and function of hepatocytes in male albino Wistar rats after supplementation of two anabolic protein supplements.

Table 2
Amino acid contents of super amino 2500/15 g protein

Item	Amount (mg)
L-alanine	180
L-arginine	218
L-aspartic acid	414
L-cystine	154
L-glutamic acid	1354
L-glycine	108
L-histidine	274
L-isoleucine	276
L-leucine	546
L-lysine	453
L-methinine	174
L-phenylalanine	306
L-proline	624
L-serine	348
L-threonine	358
L-tryptophan	172
L-tyrosine	130
L-valine	342

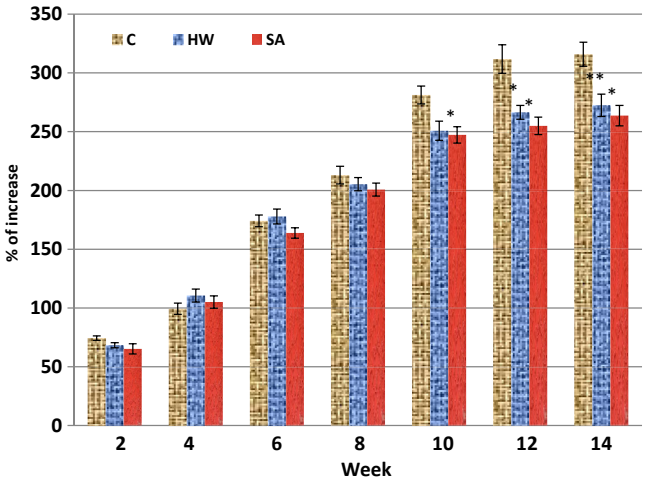

Fig. 1. Percent of increase of body weight of male rats supplemented with hyperwhey and super amino 2500 for 14 wk. Each result represents the mean ± SE (n = 5). C, control; HW, hyperwhey; SA, super amino 2500. *Nonsignificant at $P < 0.05$.

Material and methods

Hyperwhey treatment

Hyperwhey protein matrix (Nutrabolics, Richmond, British Columbia, Canada) was used. It is composed of maltodextrin, glycine, cocoa, natural and artificial flavors, cellulose gum, color, and sucralose, as well as amino acids especially glutamine or glutamic acid and taurine (Table 1). Each rat received daily oral doses of 2.5 g/kg body weight in drinking water for 14 wk. The applied dose was similar to that used in previous studies [9,11,12].

Super amino 2500 treatment

Super amino (SA) 2500 (APN, Ft. Lauderale, FL, USA) is a highly efficient protein source. It is composed of a mixture of amino acids (Table 2). Each rat received daily oral doses of 2.5 g/kg body weight in drinking water for 14 wk.

Experimental work

Thirty fertile male Wistar albino rats weighing ~60 g, obtained from Hellwan Breeding Farm, Ministry of Health, and Egypt were used for experimentation. The rats were given free access to a standard diet composed of protein (21.27%), fat (2.83%), and fiber (2.46%). Water was allowed ad libitum. They were kept in good ventilation with a 12-h light-and-dark cycle. The rats were arranged

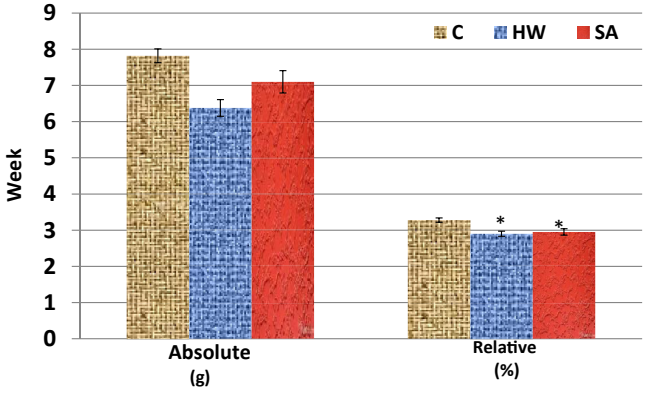

Fig. 2. Absolute and relative liver weight of male rats supplemented with hyperwhey and super amino 2500 for 14 wk. Each result represents the mean ± SE (n = 5). C, control; HW, hyperwhey; SA, super amino 2500. *Nonsignificant at $P < 0.05$.