Available online at www.sciencedirect.com
ScienceDirect
journal homepage: www.elsevier.com/locate/burns

The effect of isolated soy protein adjunctive with flaxseed oil on markers of inflammation, oxidative stress, acute phase proteins, and wound healing of burn patients; a randomized clinical trial

Siavash Babajafari [a], *Masoumeh Akhlaghi* [a], *Seyed Mohammad Mazloomi* [a], *Mehdi Ayaz* [b], *Ali Noorafshan* [c], *Peyman Jafari* [d], *Abdollah Hojhabrimanesh* [a,*]

[a] *Nutrition Research Center, School of Nutrition and Food Sciences, Shiraz University of Medical Sciences, Shiraz, Iran*
[b] *Burn Research Center, Shiraz University of Medical Sciences, Shiraz, Iran*
[c] *Histomorphometry and Stereology Research Center, Shiraz University of Medical Sciences, Shiraz, Iran*
[d] *Department of Biostatistics, Shiraz University of Medical Sciences, Shiraz, Iran*

ARTICLE INFO

Article history:
Accepted 15 May 2017
Available online xxx

Keywords:
Isolated soy protein
Flaxseed oil
Inflammation
Oxidative stress
Wound healing

ABSTRACT

Introduction: The objective was to determine the effect of isolated soy protein (ISP) and flaxseed oil (FO) on inflammatory and oxidative stress indices, acute phase proteins, and wound healing of burn patients.

Methods: One hundred eighty-eight patients were assessed for eligibility in this randomized controlled trial. Of these, seventy-three eligible patients (total burn surface area 20-50%) were randomly assigned to 3 isocaloric groups, labeled as control (wheat flour+corn oil (CO)), ISP+FO, and ISP+CO, to receive these nutrients for 3 weeks. We used intention to treat analysis to overcome bias. Because of the large perturbation in water compartments, patients received nutrients from 4th to 25th day of admission. Serum high sensitivity C-reactive protein (hs-CRP), malondialdehyde (MDA), superoxide dismutase (SOD), ferritin, albumin, and transferrin were measured. The wound area was evaluated by stereological test.

Results: During the 3-week intervention, hs-CRP (-19.4 ± 5.6, $-11.7\pm4.7\,\mu g/ml$) and ferritin (-83.8 ± 20.5, $-80.1\pm19.6\,ng/ml$) levels changes significantly reduced compared to the control group ($P<0.05$). MDA level ($-0.05\pm0.21\,\mu mol/l$) significantly decreased in group A ($P<0/05$) but was not significant in groups B and control ($P>0.05$). Albumin level (0.59 ± 0.14, $0.30\pm0.12\,g/dl$) significantly increased in group A compared to the control group ($P<0.05$), but no significant relationship was found between other groups ($P>0.05$). Transferrin level (4.9 ± 3.6, $2.9\pm5.1\,g/dl$) significantly increased in ISP groups compared to the control ($P<0.05$). SOD improved in all groups with no significant difference between them ($P>0.05$). The stereology examination showed significant improvement in wound healing in the ISP groups on days 22 and 25 compared to the control group.

* *Corresponding author*. Fax: +98 7137257288.
E-mail address: hozhabriabdollah@yahoo.com (A. Hojhabrimanesh).
http://dx.doi.org/10.1016/j.burns.2017.05.014

Conclusion: Nutritional supplements with ISP may attenuate post-burn oxidative stress and inflammation, leading to improved wound healing in burn patients. Flaxseed oil may not exert a beneficial effect over the ISP.

1. Background

Burn is a serious and debilitating injury and the 10th most common cause of accidental death in children and adults [1,2]. Burn of more than 20% of the total body's surface area results in extensive metabolic, inflammatory, endocrine, and immune deregulations that can predispose patients to malnutrition, poor wound healing, muscle wasting, severe cachexia, and frequent infections [3,4]. Nutritional support is recognized as one of the most significant aspects of care for burned patients [5]. Among various nutritional supplements, isoflavones, special amino acids, such as glutamine and arginine, and omega-3 fatty acids have shown benefits for hyper-catabolic conditions including burn [6–8]. Supro isolated soy protein from DuPont Protein International, Inc. (St. Louis, MO, USA) as a part of intervention of this study contains good quantities of amino acids, such as glutamine, arginine, branched-chain amino acids (BCAA) and isoflavones [8,9]. Soy isoflavones have anti-oxidative and anti-inflammatory effects [8,10,11]. However, as some studies have not found a beneficial effect of soy isoflavones on CRP [12]. Glutamine is the most abundant amino acid in the body, but in critical illness or injury it is drained quickly [13]. Enteral glutamine supplementation in burn patients improves wound healing and reduces blood infection, the length and cost of hospitalization, and mortality [14]. General diet usually contains less than 8% glutamine and therefore it may hardly meet glutamine requirements during critical conditions [15–17]. Arginine, another compound present in soy protein isolate also has beneficial effect on wound healing of burned rats [18] and post-burn resuscitation of humans [19]. In addition, the BCAA composition of soy protein isolate serves as a nitrogen source for glutamine and alanine synthesis in muscle. An enhanced rate of BCAA oxidation is commonly associated with systemic inflammatory response (SIRS), a host response frequently induced by severe illnesses such as burn [20]. Flaxseed oil, another food item used in this study, is a rich source of omega-3 fatty acids with anti-inflammatory effects against burn-induced inflammation [21]. In general, omega-3 fatty acids have been found to be beneficial in wound healing [22] and immune function [23,24].

Despite great advance in medical sciences, the role of nutrition in the treatment of patients with a critical condition is often ignored. No human study so far has examined the wound-healing effect of nutritious foods, for instance, isolated soy protein with or without flaxseed oil, in burn patients. In the current study, we used snacks containing isolated soy protein and flaxseed oil in the regimen of burn patients while monitoring their wound healing, plasma proteins, and markers of inflammation and oxidative stress over a 21-day period.

2. Methods

2.1. Study design and patients

In this placebo-controlled, double-blind, parallel-group, randomized clinical trial, 73 patients with mild to moderate burn were recruited from the Institute of Burn Research of Qutb al-Din hospital in Shiraz, Iran. Using simple randomization [25], participants were assigned in a 1:1:1 fashion to 3 equal groups, labeled as ISP+flaxseed oil (group A), ISP+corn oil (group B) and wheat flour+corn oil (control product) for 3 weeks. Because of the large perturbation in water compartments of burn body patients that occurred after admission time, we were taken fasting venous blood samples in the morning of 4th day and on day 25. Inclusion criteria included: the burn magnitude of 20-50% of total body surface area (TBSA), hospitalization within 24 h post-burn, the age of 15–60 years, the body mass index (BMI) of 18-30 kg/m^2, and willingness to participate. Patients with renal or hepatic failure, severe inhalation injury, excessive hemorrhage, allergy to soy, and those who were using omega-3 fatty acids in the previous month or needed parenteral or enteral nutritional support and mechanical ventilation support were not included. The ethics board of Shiraz University of Medical Sciences, Shiraz, Iran, approved the study protocol (reference number: CT-92-6878). All procedures followed were in accordance with the ethical standards laid down in the Declaration of Helsinki and its later amendments [26]. All patients or their close relatives provided written, informed consent prior to enrolment. This trial was registered at http://www.irct.ir as IRCT2014051817740N1.

Written informed consent was obtained from participants or their close relatives. The study was conducted in accordance with the ethical standards of the responsible Committee on Human Experimentation (institutional and regional) and the guidelines for the design, conduct and reporting of human intervention studies [27].

2.2. Intervention

The patients were randomly assigned to one of the three groups: Group A: snacks containing isolated soy protein +flaxseed oil (n=25); group B: snacks containing isolated soy protein+corn oil (n=24); group C: (control product): snacks containing wheat flour+corn oil (n=24). Participants were asked to avoid nutritional supplements, isoflavones or phytate-rich foods during the treatment period. After admission, all patients received conventional wound management, fluid replacement and tracheotomy.

All the operations were done under general anesthesia. Patients were being grafted, were equally distributed between the groups so anesthesia method of patients being grafted

Please cite this article in press as: S. Babajafari, et al., The effect of isolated soy protein adjunctive with flaxseed oil on markers of inflammation, oxidative stress, acute phase proteins, and wound healing of burn patients; a randomized clinical trial, Burns (2017), http://dx.doi.org/10.1016/j.burns.2017.05.014