Food and Chemical Toxicology 55 (2013) 371–377

Contents lists available at SciVerse ScienceDirect

Food and Chemical Toxicology

journal homepage: www.elsevier.com/locate/foodchemtox

The effect of apricots on the experimental cataract model formed by sodium selenite

Selim Doganay [a,*], Cem Duz [b], Penpe Gul Firat [a], Cem Cankaya [c], Derya Kutukde [a], Yılmaz Cigremis [d]

[a] Inonu University School of Medicine, Department of Ophthalmology, Malatya, Turkey
[b] Beydagi State Hospital, Department of Ophthalmology, Malatya, Turkey
[c] Universal Malatya Hospital, Department of Ophthalmology, Malatya, Turkey
[d] Inonu University School of Medicine, Department of Medical Biology and Genetics, Malatya, Turkey

ARTICLE INFO

Article history:
Received 16 July 2012
Accepted 19 December 2012
Available online 21 January 2013

Keywords:
Sodium selenite
Experimental cataract
Antioxidant
Apricot
Cataract

ABSTRACT

This study was designed in order to investigate whether sun dried apricots have a preventive effect on the experimental cataract model formed by sodium selenite in rats. Fifty-nine Spraque-Dawley rat pups were divided into three groups. Group 1 (control group) consisted of twenty rat pups, born from the rats nourished ad libitum. Group 2 consisted of 18 newborn rats, born from the rats nourished ad libitum with 10% sun dried natural apricots. Group 3 consisted of 21 newborn rats, born from the rats nourished ad libitum. Subcutaneous (30 nmol/gr) sodium selenite injection was applied to all the newborn rats except the control group (Group 1) on postpartum day 10. Cataract development was graded by slit-lamp examination and photography. Encapsulated lenses were analyzed for reduced glutathione (GSH) and malondialdehyde (MDA), a marker of lipid per oxidation.

Lenses were also analyzed for total nitrite (TN). The presence of oxidative stress in selenite cataract development and its prevention by sun dried apricots.

1. Introduction

The underlying mechanism of age-related cataracts is not still fully understood. A decrease in antioxidant enzymes in the lens and an increase of free oxygen radicals are the factors that play a role in the formation of age-related cataract formation. In 1990, the World Health Organization reported that for 41.8% of the 38 million blind people, approximately 16 million, the cause of blindness is cataracts (Thylefors et al., 1995). The World Health Organization also reports that in 2020, the number of people blind due to cataracts will reach approximately 40 million. This result means that the amount of surgery which is the only treatment modality will increase threefold. If the onset of cataracts is delayed ten years, the annual number of operations will be expected to decline by 45% (West and Valmadrid, 1995; Livingston et al., 1995). Therefore, identifying the risk factors for cataracts is very important. Nutrition is one of the most important factors that play a role in the formation of age-related cataracts.

Not only aging, but also congenital, metabolic, or traumatic factors may cause cataracts formation. Due to the prevalence of senile cataracts, they have the most important socio-economic effects.

Until now there has been no research which investigated the antioxidant properties of apricots with regards to cataract formation. Apricots include major provitamin carotenoids. These carotenoids play an important role in protecting cells against damage caused by free radicals. It has been shown that beta-carotenoid reduces the incidence of liver and gastrointestinal tract cancers. Beta-carotenoid is transported in plasma by LDL and beta carotenoid takes a protective role in the prevention of the oxidation of LDL. For this reason, it is hypothesized that beta-carotenoid enriched diets and diets rich in fruit and vegetables decrease the risk of cardiovascular disorders. Carotenoids also take a role in the development of a lot of tissue, in particular eye and skin. Beta carotenoid rich diets are recommended for delaying aging (de Lourdes Moreno et al., 2012). For this reason, the consumption of the high-carotene content found in apricots is also important for a healthy life. According to our knowledge there are no studies investigating the effect of apricots on eyes. However, many studies have shown that antioxidant properties of vitamins and other metabolites found in apricots prevent cataract formation.

To determine the mechanism of age-related cataract formation most commonly used experimental model of cataract is the selenite-induced cataract model. This model provides important facilities for cataract formation with its quick and reproducible properties (Shearer et al., 1997).

The ability of selenite to cause cataracts was first reported by Ostadova et al. (1978). Selenite cataract is usually produced within 4–6 days by single subcutaneous injection of 19–30 μmol/kg body

* Corresponding author. Address: Inonu University School of Medicine, Turgut Ozal Medical Center, Department of Ophthalmology, TR-44280 Malatya, Turkey. Tel.: +90 422 341 06 60; fax: +90 422 341 07 28.
E-mail address: odoganay@windowslive.com (S. Doganay).

0278-6915/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.fct.2012.12.061

weight of sodium selenite into suckling rats of 10–14 days of age (Shearer et al., 1997). Several biochemical processes such as altered epithelial metabolism, calcium accumulation, crystalline precipitation, and cytoskeletal loss occur during the development of selenite-induced cataract (Shearer et al., 1997). It is generally accepted that oxidative insult plays a key role in the opacification process and that redox cycling is important for the maintenance of lens transparency (Giblin et al., 1976). Selenite administration results in lipid peroxidation, hydrogen peroxide formation, and a decrease in reduced glutathione (GSH) level in rat lenses (David and Shearer, 1984). Active oxygen generation has been demonstrated after reaction of selenite with reduced GSH (Seko et al., 1989). In the current study, we have assessed whether sun dried apricots prevents selenite cataract formation and have investigated its effects on the status of GSH, malondialdehyde (MDA) (a marker of lipid peroxidation) and in total nitrite (TN) levels in lenses. Also, morphological cataract staging was used to evaluate the morphologic effects of apricots.

2. Materials and methods

2.1. Animals-experimental design

The study was initiated after confirmation of Inonu University ethics committee for experimental animals. Sprague Dawley rats which were obtained from the experimental animal center of Inonu University were used in research. Rats were divided into three groups. The first group was identified as the control group; the other two groups were identified as the study groups. Rats were accommodated in standard conditions (12 h of daylight, 12 h dark, in ventilated rooms of a constant temperature).

To get pups for three study groups, 8 adult female and 4 adult male Spraque Dawley rats were used:Firstly, the adult rats were divided into four groups:

1. *Adult Group:* 2 adult male rats. This group was fed with feed containing 10% natural sun dried apricots ad libitum feed for 1 month.
2. *Adult Group:* 4 adult female rats. This group was fed with feed containing 10% natural sun dried apricots ad libitum for 1 month.
3. *Adult Group:* 2 male rats. This group was fed with normal feed ad libitum for 1 month.
4. *Adult Group:* 4 female rats. This group was fed with normal feed ad libitum for 1 month.

After a month the groups fed with the normal feed and feed with apricots were matched with each other. Female rats were placed in separate cages and nutrition continued in the same way.

Adult female rats gave birth about 3 weeks later. Fifty-nine Spraque-Dawley rat pups were divided into three groups. Group 1 (control group) consisted of twenty rat pups, born from the rats nourished ad libitum. Group 2 consisted of 18 newborn rats, born from the rats nourished ad libitum with 10% sun dried natural apricots. Group 3 consisted of 21 newborn rats, born from the rats nourished ad libitum. Subcutaneous (30 nmol/gr) sodium selenite injection was applied to all the newborn rats except the control group (Group 1) on postpartum day 10. The pups were fed with breast milk until the third week. Mothers were fed same way. After that, their mothers left. Rats in Group 1 and Group 3 were fed with normal feed ad libitum. Rats in Group 2 were fed containing 10% natural sun dried apricots ad libitum. Nutrition was continued for five weeks.

The rats were examined 8 weeks after birth. Their weights were 145–195 g. There were 11 male rats and 9 female rats in the first group. There were 10 female and 8 male rats in the second group. There were 10 female, 11 male rats in the third group. To provide general anesthesia, the rats were given intramuscular ketamine hydrochloride (75 mg/kg) and xylazine (8 mg/kg). Tropicamide 0.05% and phenylephrine 2.5% were used for the dilation of the pupil. The drops were repeated for 2 h at 30 min intervals. Biomicroscopical examination was performed after pupillary dilation for the staging of cataracts. Photographs were taken (Nikon photoslite-lamp, 25× magnifications, FS-3V, Japan).

By posterior approach all the lenses were removed together with the capsules. Lenses of the same group of rats were separated into two tubes. Total glutathione (GSH), malondialdehyde (MDA) and nitrite levels (NO) were measured.

2.2. Staging of cataracts

The cataract grading was performed using a Nikon FS-3V biomicroscope. Images were taken with a camera attached to the biomicroscope which has a 25 magnification. The Hiraoka and Clark cataract classification was used for the staging (Hiraoka and Clark, 1995).

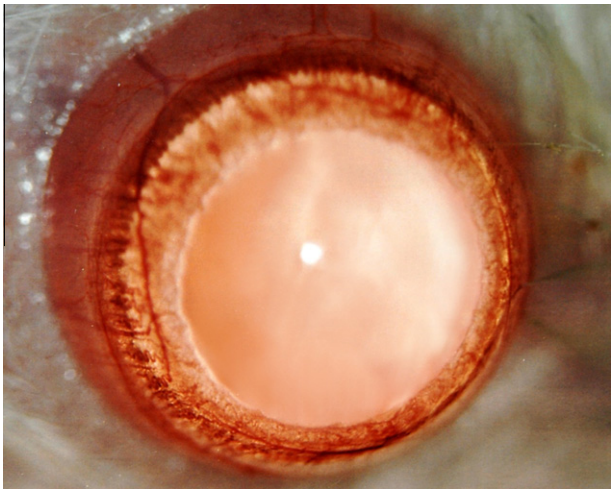

Fig. 1. Normal clear lens (Stage 0 cataract).

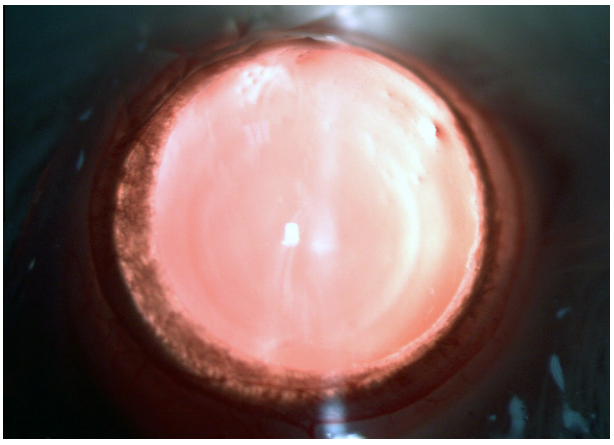

Fig. 2. Early posterior subcapsular cataract or minimal nuclear opacity (Stage 1 cataract).

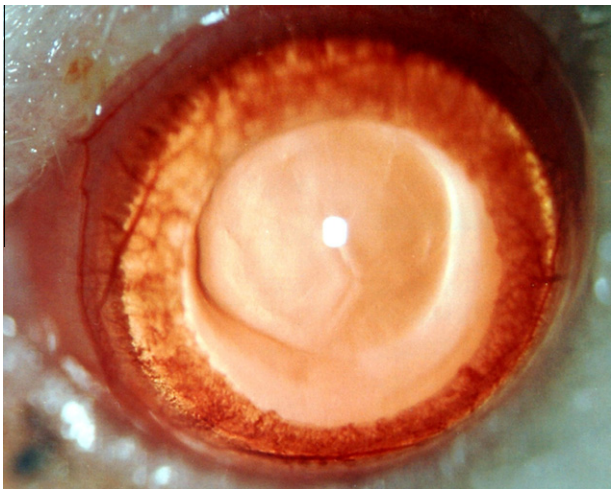

Fig. 3. Nuclear opacity in which swollen fibers or a posterior subscapular opacity produces scattering (Stage 2 cataract).

Stage 0: Normal clear lens (Fig. 1).
Stage 1: Early posterior subcapsular cataract or minimal nuclear opacity (Fig. 2).
Stage 2: Nuclear opacity in which swollen fibers or a posterior subscapular opacity produces scattering (Fig. 3).