Food and Chemical Toxicology 49 (2011) 678–684

Contents lists available at ScienceDirect

Food and Chemical Toxicology

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

Studies on neurolathyrism in Ethiopia: Dietary habits, perception of risks and prevention

A. Fikre [a], M. Van Moorhem [b,*], S. Ahmed [c], F. Lambein [d], G. Gheysen [e]

[a] Ethiopian Institute for Agricultural Research (EIAR), Debre Zeit Center, P.O. Box 32, Debre Zeit, Ethiopia
[b] Department of Basic Medical Sciences – Physiology group, Faculty of Medicine and Health Sciences, De Pintelaan 185 (Block B, 3rd Floor), Ghent University, B-9000 Ghent, Belgium
[c] International Centre for Agricultural Research in the Dry Areas (ICARDA) P.O. Box 5466, Aleppo, Syria
[d] Institute Plant Biotechnology for Developing Countries (IPBO), Department of Molecular genetics, Faculty of Sciences, K.L. Ledeganckstraat 35, Ghent University, B-9000 Ghent, Belgium
[e] Department of Molecular Biotechnology, Faculty of Bioscience Engineering, Coupure Links 653, Ghent University, B-9000 Ghent, Belgium

ARTICLE INFO

Article history:
Available online 13 October 2010

Keywords:
Neurolathyrism
Lathyrus sativus
Woito tribe

ABSTRACT

This study describes the correlation of traditional perceptions and dietary habits with the incidence of neurolathyrism to propose preventive measures. Therefore, 118 households of South Wollo and North Gondar (Amhara Regional State, Ethiopia), of which one third had at least one neurolathyrism affected member, were interviewed.

Most of the affected families in this study had one neurolathyrism victim, being predominantly male and of younger age. The incidence among youngsters (boys and girls) was significantly correlated with the consumption of green unripe seeds (*eshet*), confirming this as a risk factor for developing neurolathyrism. The consumption of other popular grass pea preparations was not age related. Neurolathyrism patients did not attempt any medication as most people knew that neurolathyrism is incurable, but the consumption of grass pea was abandoned after developing the disease. The minority 'Woito' tribe was virtually unaffected. They were the only people reporting to consume fish which is rich in amino acids such as methionine and using metallic kitchen utensils in addition to clay pots. This observation points to the correlation between low neurolathyrism incidence and a better balanced diet as well as metallic kitchen utensils, suggesting a new approach for neurolathyrism prevention.

1. Introduction

Excessive consumption of grass pea (*Lathyrus sativus* L., *Guaya* in Amharic, *Gayo* in Oromifa, *Sebere* in Tigrigna) can cause the irreversibly crippling disease neurolathyrism (Spencer and Schaumburg, 1983), characterized by scissor gate and spastic contraction of the calf muscles ('*yeguaya beshita*' or broken legs in Amharic language). These symptoms are caused by symmetrical degeneration of pyramidal tracts in the spinal cord (Striefler et al., 1977) and loss of pyramidal cells in the area of the brain cortex controlling the leg movements (Haimanot et al., 1990). Avoiding grass pea consumption is no option, since it is the life-saving crop of poor farmers in remote and drought prone areas of Ethiopia. It grows on poor soil and survives drought better than any other legume or cereal crop. Used as a tasty pulse in normal conditions, it becomes the staple food during drought; then it appears to become toxic for many uninformed consumers. Next to being life-saving during drought, consumption of grass pea also has a deep rooted tradition in Ethiopian culture and is used at special social occasions such as funerals. At least ten different traditional foods are prepared from grass pea (see Table 1): The most common preparations are *wott* (the sauce prepared from whole seed as *shiro wott*, or from the split cotyledons as *kik wott*), *nifro* (boiled seeds) and *eshet* (green unripe seeds often eaten as snack by young boys on the way from school to home). Less common are roasted seeds (*kollo*), boiled seeds (*nifro*), unleavened bread (*kita*), pancake-like bread (*injera*) and gravy (*shiro*) (Haimanot et al., 1993; Getahun et al., 1999), split cotyledons (*kik*), fermented and spiced sauce (*elbet*), thickened pancake-like bread (*seteto*) and porridge made from grass pea and various other seeds.

The popularity of *wott* is mainly due to its combination with the pancake-like bread '*injera*', the traditional Ethiopian food made from fermented cereals (mostly teff, *Eragrostis teff*) (Haimanot et al., 1995). The sauce *wott* is usually prepared in clay pots and is based on *shiro*, flour prepared from pure or mixed legumes including grass pea. *Injera* made of fermented grass pea itself was also reported recently (Getahun et al., 2005).

The most toxic preparations are *eshet* (green unripe seeds), *kollo* (roasted seeds) and *kita* (unleavened bread). Fortunately the

* Corresponding author. Tel.: +32 9 332 39 73; fax: +32 9 332 30 59.
E-mail address: marijkevanmoorhem@hotmail.com (M. Van Moorhem).

0278-6915/$ - see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.fct.2010.09.035

Table 1
Grass pea food types, processing, consumption level in Ethiopia and gradation of risk as perceived from the literature.

Grass pea food	Ingredients	Processing	Consumption level	Gradation of risk
Shiro wott sauce	Grass pea ± other pulses + spice condiments	Grass pea gravy as a major component of sauce	High	Low
Kik wott sauce from split grass pea seeds	Roasted and split grass pea + spice condiments	Sauce prepared using split grass pea as major component	High	Medium
Nifro boiled grass pea seeds	Grass pea ± cereals	Directly boiled grass pea, water decanted and consumed	Medium–high	Medium
Kollo roasted grass pea seeds	Grass pea	Commonly roasted after soaking or mild boiling and decanting the water	Low–edium	High
Kita unleavened bread	Powder of grass pea ± cereals	Unfermented dough is baked with metallic or clay pans and consumed alone or with sauce	Low	High
Injera pancake bread	Powder of grass pea + cereals	An overnight fermented viscous dough is baked in clay pans and consumed with sauce	Low	Very low
Seteto	Same as injera	Made by hand a bit thicker than injera and with no 'eyes'	Very low	Very low
Elbet	Powder of grass pea ± other pulses + spices	Roasted powder is well spiced and fermented for longer time; commonly consumed during fasting period	Low	Low-medium
Porridge	Powder of grass pea ± cereals	Powder is made into moistened baked dough and consumed with oily fats	Low	Medium–high
Eshet Green pea	Immature grass pea	Hand picking in the farm field and consumed while walking home	Medium–high	Very high

consumption level for these preparations is rather low, except for the green unripe seeds. Unleavened bread is used mostly in times of acute food shortage (Haimanot et al., 1995).

Popular misconceptions about grass pea food and the causes of neurolathyrism are linked either to inhalation of vapours or to physical contact. This may be explained by the months-long consumption before the sudden onset of symptoms, which for most people disconnects the cause from the disease. This tasty seed that kept farmers alive during the drought is considered a blessing by many, and blaming this benefactor as the cause of the irreversible crippling is beyond their comprehension. Most people associate neurolathyrism with physical contact with grass pea, such as walking through a flowering field or lying on the straw and the stalks. During grass pea food preparations, inhalation of the smoke while roasting or the steam while boiling is blamed as an immediate cause, both by farmers and health workers. Consuming raw grass pea with milk was also a frequently cited factor. A higher incidence of neurolathyrism among the community was associated with illiteracy and with absence of an earlier neurolathyrism patient at home (Getahun et al., 2002; Haimanot et al., 2005). Negligence or poor knowledge must have magnified the impact of grass pea on the socio-economic condition of a community by increasing the number of permanently crippled neurolathyrism cases that become totally dependent on their families and the community.

Long established cautionary measures to prevent neurolathyrism are traditionally used by grass pea consuming communities. These include boiling the seed and decanting the used water, cooking (Urga et al., 1994; Akalu et al., 1998; Getahun et al., 2003; Getahun et al., 2005), soaking (Akalu et al., 1998; Getahun et al., 2005), dehusking (Haimanot et al., 2005), mixing with other foodstuffs and fermentation (Getahun et al., 2003). Some of those measures, such as avoiding contact with vapour emanating from grass pea stalk or boiling seeds, or avoiding consumption of milk together with grass pea, have no proven scientific basis.

Several studies have been conducted into the epidemiology of neurolathyrism, the socio-economic associations of the disease and the preparation and consumption of grass pea foods (Haimanot et al., 1995; Haque et al., 1996; Getahun et al., 2003; Getahun et al., 2005). This paper discusses some additional but salient parameters that should be considered important knowledge for health workers and social workers to help with the solution and the prevention of this vicious medical and socio-economic problem of neurolathyrism.

2. Objectives of the study

- To assess the position of grass pea food traditions, indigenous knowledge and perception, and symptomatic responses to treatment of neurolathyrism victims among the local communities in risk areas.
- To give an evaluation of the traditional perceptions of risk and protective factors.
- To identify or evaluate proposed risk factors and propose preventive measures that may contribute to the reduction of the occurrence of neurolathyrism in the future.

3. Subjects and methods

3.1. The study areas

The study has been conducted in high grass pea consumption districts of two administrative zones located at the Northeast and Northwest of the country in the Amhara Regional State, Ethiopia (see Fig. 1). The three woredas (administrative divisions), Legambo and Wegdi under South Wollo Zone and Gonder Zuria under North Gonder Zone, are known for their grass pea production (>2000 ha) (CSA, 2005), grass pea consumption and high prevalence of neurolathyrism (Haimanot et al., 1993; Haimanot et al., 2005). Gondar Zuria is also the home of major groups of the minority Woito tribe (Wudneh, 1998).

The Legambo and Wegdi woredas (South Wollo) are located on highland and are at about 2900 m above sea level (a.s.l.) while Gonder Zuria (North Gonder) is located at about 2200 m a.s.l. along the Lake Tana, the biggest lake of Ethiopia. It is estimated that 264,900; 215,500 and 137,300 people of low economic status are living in the Gonder Zuria, Legambo and Wegdi woredas respectively (CSA, 2005).

3.2. Communities

The study was performed at community level within the woredas Legambo, Wegdi and Gonder Zuria. For logistic reasons the coverage of the study could not exceed these three woredas. A community is a group of people having a set of common factors binding them in some particular dimension. Accordingly a community, beholding between 75 and 250 households, comprising five or more tightly closed villages (smallest geographical unit),