

FRUIT PRODUCTION AND BIOCHEMICAL ASPECTS OF SEEDS OF *EURYALE FEROX* SALISB. UNDER *EX-SITU* CONDITIONS

MD. ALMUJADDADE ALFASANE*, MONIRUZZAMAN KHONDKER, Z. N. TAHMIDA BEGUM,
LAILA ARJUMAND BANU¹, MD. MAHBUBAR RAHMAN¹ AND UMMA FATEMA SHAHJADEE¹

Department of Botany, University of Dhaka, Dhaka-1000, Bangladesh

Key words: Euryale ferox, Ex-situ culture, Fruit production, Seeds biochemical content

Abstract

Ex-situ culture studies of *Euryale ferox* Salisb. using fresh mature seeds were carried out in an arboretum. Production of fresh fruit has been estimated to be 3.05 t/ha. Biochemical analysis of the seeds revealed 61% carbohydrate, 15.6% protein, 12.1% moisture, 7.6% fibre, 1.8% ash and 1.35% fat. The seeds were found to contain 12 amino acids, which are histidine, leucine, isoleucine, glutamic acid, lysine, tyrosine, valine, aspartic, threonine, alanine, methionine and arginine.

Introduction

Seeds of *Euryale ferox* Salisb. is eaten raw in many parts of Bangladesh as well as in some other countries of South East Asia. Fruits of *E. ferox* are known as 'Makhna' in Bangladesh. Haor basins of Kishoreganj, Maulvi Bazar and Sylhet districts and in some parts of Naogaon district of Bangladesh are the areas of large scale production. Poor residents of the Haor basin are dependent fully on the natural production of Makhna fruits. But no effort was taken to cultivate Makhna *ex-situ* or to analyse the contents of its seeds in terms of protein, carbohydrate, fats, etc. (Majid 1986, Irfanullah 2002).

In the present study, an *ex-situ* culture of *E. ferox* for the production of Makhna fruits, and also biochemical contents of seeds produced have been investigated.

Materials and Methods

Euryale ferox Salisb. was propagated via seeds. Fresh and mature fruits of *E. ferox* were collected on April 26, 2002 from a local market of Dhaka metropolis where the item is regularly sold. After the fruits were brought to the laboratory it was incised and the seeds were taken out and set for germination. The germination was carried out in an earthen bin. It had a diameter of 77 cm and a depth of 40 cm and buried on the ground in such a way that the rim remains 6 cm above. Nearly one third of the volume of the bin was filled with 10 kg loam mixed with composted cow dung (1 : 1) and then it was filled with tap water. At the end of April 2002, a perforated poly-bag containing 30 healthy seeds of *E. ferox* were sown in the soft and submerged mud of the bin. At the time of germination following environmental factors such as air temp. (31°C), water temp. (33°C), pH (7.17), TDS (302 mg/l), conductivity of water (664 µS/cm, alkalinity (3.15 meq/l), and DO (12.20 mg/l) were recorded. After a period of three - four weeks, 14 seeds germinated. The seedlings were transferred after a month to another smaller shallow concrete tank situated at the Botanical garden, Department of Botany, University of Dhaka. In June, the plantlets grew up to 30 - 40 cm in height, and the plantlets were transferred to a concrete cistern of 90 cm wide and 200 cm long, where the bottom was filled with composted cow dung mixed with loam up to 30 cm height. Immediately after transplantation tap water was added in the cistern in such a way that only the leaves of the plants remained afloat. The water surface was adjusted every day as per growth of plants.

*Corresponding author. ¹BCSIR Laboratories, Dhaka, Bangladesh.

Fresh seeds obtained from 36 mature fruits of *E. ferox* were crushed in a mortar with a pestle. The crushed material was used to determine the amount of protein, ash, fat, moisture, fibre and carbohydrate content (Nat. Inst. Nutr. 1976). Moisture content was determined with the help of a moisture meter (IB-30, Brand Chyo) and protein was determined by Microkjeldhal method. The ash content was determined in a Muffle furnace (Carbolite RHF-1600).

For analysis of amino acids, seeds were crushed and a fine paste was made by mortar and pestle and transferred in 250 ml round bottom flask placed in a heating mantle at 110°C for 24 h with 6N HCl. The solution obtained was kept in an evaporating dish to evaporate HCl on water bath. It was then filtered to 25 ml volumetric flask through Whatman No. 9 filter paper and columned with 0.1N HCl. The solution was run through an Amino acid analyser (Schimadzu, Japan). The analyser showed the standard curve for standard solution and another curve for sample solution. By comparing the two curves the amount of amino acids was calculated.

Results and Discussion

E. ferox is a hermaphrodite plant having small violet-blue flowers, with petals paling to white in the centre, and up to 4 - 5 cm long. The flowers remain just above the water during the summer and short lived. The rounded dark purple fruits were 5 - 10 cm in diameter and contain 78.4 ± 30.8 round black seeds and 6 - 10 mm in diameter (Fig. 1). Fresh weight of each seed is 0.97 g. *E. ferox* produces 8 - 25 fruits per year per plant and the mean fresh weight of each fruit is about 157.3 g. A production of 3.05 ton/ha of fresh fruit could be achieved by applying the present culture technique.

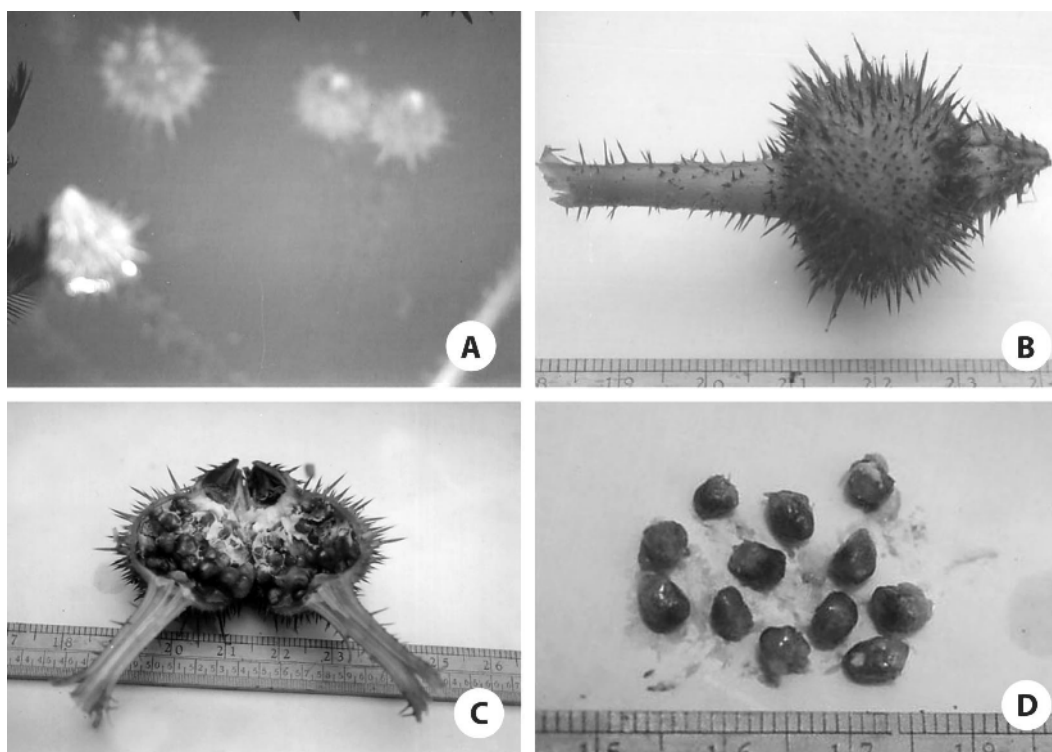


Fig. 1A-D: A. Fruits of *Euryale ferox* just beneath the surface of water of the culture pit. B. A whole fruit with dense spines. C. An incised fruit showing the arrangement of seeds. D. Seeds.

During the present investigation, biochemical analyses of seeds of *E. ferox* showed that seeds are extremely nutritious, containing of 61.2% carbohydrate, 15.6% protein, 1.3% fat, 7.6% fibre, 1.8% ash and 12.5% moisture. The food value of 100 g of seeds is equal to the same amount of fish. Read (1946) reported biochemical composition of *E. ferox* and found to be composed of carbohydrate (75.7%), protein (9.9%), fat (0.3%), and ash (0.6%). In the present material protein content was 1.6 times higher while fat content was about 5 times higher than that reported by Read (1946).

Table 1. Amino acids in the seeds of *Euryale ferox*.

Amino acid	% of dry weight	Amino acid	% of dry weight
Aspartic acid	0.33	Isoleucine	1.07
Threonine	0.60	Leucine	1.44
Glutamic acid	0.92	Tyrosine	0.83
Alanine	0.46	Histidine	1.60
Valine	0.82	Lysine	0.88
Methionine	0.36	Arginine	0.60

Thus seeds of *E. ferox* during present investigation contained a total of 12 amino acids (Table 1). Das *et al.* (2006) reported cardioprotective properties of *E. ferox* and suggested that such cardioprotective properties may be linked with the ability of *E. ferox* to induce thioredoxin-related protein-32 (TRP32) and thioredoxin-1 (Trx-1) proteins and to scavenge reactive oxygen species (ROS). The seeds are also of great traditional medicinal value. According to Phang (2002) protein of *Arthrospira* (= *Spirulina*), a non-conventional aquatic source of nutrition contains isoleucine (3.5 - 4.1%), leucine (5.4 - 5.8%), lysine (2.9 - 4.0 %), methionine (3.5 - 4.1%), phenylalanine (2.8 - 4.0%), threonine (3.2 - 4.2%), tryptophan (0.91-1.1%) and valine (4.0-6.0%). It appeared that the contents of different amino acids in the seeds of *E. ferox* (Table 1) is low compared to those of *Arthrospira*. However, the carbohydrate content of the *E. ferox* (61.2%) is higher than that of *Spirulina* (13 - 25%).

References

- Das, S., P. Der, U. Raychaudhuri, N. Maulik and D.K. Das. 2006. The Effect of *Euryale ferox* (Makhana), an Herb of Aquatic Origin, on Myocardial Ischemic Reperfusion Injury. *Molecular and Cellular Biochem., Biomed. and Life Sci.*, Springer, Netherlands. pp. 55-63.
- Irfanullah, H.M. 2002. Studies on aquatic vascular plants in Bangladesh: An appraisal. *Bangladesh J. Plant Taxon.* 9(1): 85-116.
- Majid, F.Z. 1986. Aquatic weeds. Utility and development. *Agro Bot. Publ.*, India. pp. 96.
- National Institute Nutrition. 1976. A manual of laboratory techniques. Indian Council of Medical Res., Hyderabad, India. pp. 1-3.
- Phang, S.M. 2002. *Arthrospira* Stizenb. ex Gomont. *In: Plant Resources of South-East Asia.* 15(1). Cryptogams: Algae (Prud'homme van Reine, W.F. and Trono Jr., G.C. Eds.) Prosea, Bogor, Indonesia. pp. 88-94.
- Read, B.E. (Ed.). 1946. Famine foods listed in the Chiu huang pen ts'ao [of Ting Wang Chou]: giving their identity, nutritional values and notes on their preparation. Shanghai, China: Henry Lester Institute of Medical Research. pp. 93.

(Manuscript received on 23 July, 2008; revised on 25 October, 2008)