ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2018; 4(10): 114-116
www.allresearchjournal.com
Received: 19-08-2018
Accepted: 20-09-2018

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Studies on leaf protein concentrate (LPC) in some species of *Curcuma* L. (Zingiberaceae)

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Abstract
Proteins are the basic constituents of all living things and it is a nutritional essential for animal, which occurs in varying amounts in almost all of our food. Due to the relative abundance of protein in leaf material and basic need for protein in human diet scientists have tried to prepare edible proteins from green plant tissues. Leaves are a potential source of low coast proteins. Current study was made to determine the leaf protein content (LPC) in five different *Curcuma* species namely *Curcuma longa* L., *C. inodora* Blatt, *C. neilgherrensis* Wight, *C. scaposa* (Nimmo) Skornick. & M. Sabu and *C. pseudomontana* J. Grahm by heat coagulation method. Results showed that *C. inodora* contain 3.4 % as highest amount of leaf protein and *C. neilgherrensis* 1.6 % has minimum amount of protein. Whereas leaf of *C. pseudomontana* contains highest amount of fibre 12.30 % and *C. inodora* has minimum fibre content among the selected species.

Keywords: LPC, *Curcuma*, protein, fibre

Introduction
Presently, world is coming to recognize the grim truth that ultimately the population growth will outstrip food suppliers with apocalyptic results and near about 36 million people die per year due to hunger or as a result of hunger. Approximately, 60% of the 10.9 million deaths each year among children are bellow the age of five in the developing countries are attributed to malnutrition and protein deficiency is one of the major nutritional problems in the developing world. The development of novel protein sources such as Fish Protein Concentrate (FPC), Single Cell Protein (SCP) and Soybean Protein (SBP) as well as Leaf Protein Concentrate (LPC) has made significant contributions toward the alleviation of the world protein deficiency (Ghaly and Alkoaik, 2010) [4]. The food shortage cannot be alleviated by conventional agriculture alone and there is need of an additional source of protein, the leaf protein concentrates (LPC) should be given serious attention because leaves are abundant and many have high protein content. The yield per hectare per year of leaf proteins can be at least four times higher than that of seed proteins. Currently leaf protein concentrates for animal feed are manufactured from alfalfa in Europe, as well as recently new processing plant was started in the United States (Lehel Telek,).

The green leafy vegetables have long been recognized as the cheapest and rich source of protein which has prime importance to health. However, it is observed that, proteins are often deficient in the diets of people in most of the developing countries, particularly those in the vulnerable groups, nursing and expectant mothers, weaning and preschool children. Protein deficiency may lead to high mortality and lowered resistance to disease, especially in childhood age. In view of the economic situation in the rural areas, it is essential to search other economically inexpensive sources of good quality protein that can be used as alternatives source to expensive animal protein. It was felt that a local substitute such as leaf protein concentrate might decrease the cost of animal protein (Emmanuel and Folasade, 2011) [3].

In many developing countries, protein demand for human nutrition has tremendously increased. Faced with limited amount of agricultural land and rapid population growth, scientist have made a great effort to find out some additional nutrition source to prevent millions of people dying from starvation and illness from protein deficiency (Chou, *et al.*, 1975) [5].

Due to the increase in world's population as well as food scarcity, the development of new protein sources has been a high priority research goal from past few decades (Hall, *et al*., 1975) [1]. The significant procedures for utilizing protein in green plant tissue for no ruminants is the production of leaf protein concentrate (LPC), which is prepared by expressing plant juice with a press and coagulating soluble protein in juice. The leaf protein concentrate prepared from alfalfa has given growth performance similar to that obtained with soybean meal with swine and with poultry (Cheeke, *et al*., 1981) [6].

Material and methods

The samples of *Curcuma longa* L., *C. inodora* Blatt., *C. neilgherrensis* Wight., *C. scaposa* (Nimmo) Skornick. & M. Sabu and *C. pseudomontana* J. Grahm were collected from the different localities of Maharashtra and identified by using reliable literature (Naik, 1998, Sharma, *et al*., 1996, Sabu, 2006, Yadav and Sardesai 2002) [7, 8, 9, 10]. The *Curcuma* species were cultivated in department of Botany, Vivekanand College, Aurangabad, as well as in backyard. The herbarium specimens are deposited in VH Herbarium, department of Botany, Vivekanand Arts, Sardar Dalipsingh Commerce and Science College, Samarth Nagar, Aurangabad. The mature leaves of selected species were collected and used for the preparation of leaf protein concentrate (LPC).

Leaf protein concentrate was studied by using heat coagulation method, for this fresh and healthy leaves of selected *Curcuma* species were taken. The leaves washed with running tap water and crushed with mortal and pestle to make fine paste. The pulp was squeezed with the help of musclin cloth; filtrate (juice) and residue (fibre) were obtained. The juice was added in warm water with continuous starring and filtered through pre weighted What man filter paper; the residue is known leaf protein concentrate and filtrate is deproteinized juice (DPJ).

Results and discussion

The LPC samples were much lower in protein and higher in fibre content (Table l) than is usually the case for LPC, which typically has values 1.6 to 3.4% of leaf protein concentrate in *Curcuma* species. The percent fibre content is observed between 6.0 to 12.30 % in the selected species. The percent LPC in different species of *Curcuma* were found as 2.9, 3.4, 1.6, 2.5 and 2.0 % for *Curcuma longa*, *C. inodora*, *C. neilgherrensis*, *C. scaposa* and *C pseudomontana* respectively. Whereas, percent fibre content was recorded as 11.90, 6.0, 9.20, 10.10 and 12.30 for *Curcuma longa*, *C. inodora*, *C. neilgherrensis*, *C. scaposa* and *C pseudomontana* respectively (Table 1, Fig. 1). The minimum leaf protein content (1.6%) was recorded in *Curcuma neilgherrensis* Wight, while maximum in *Curcuma inodora* Blatt (3.4%). The maximum percent fibre content was calculated in leaf of *Curcuma pseudomontana* (12.30) and minimum in *Curcuma inodora* leaves (6.0 %).

Table 1: Leaf protein concentrates and fibre content in different *Curcuma* species

Sr. no	Name of species	Leaf protein content (%)	Fibre content (%)
1	*Curcuma longa* L.	2.9	11.90
2	*Curcuma inodora* Blatt.	3.4	6.00
3	*Curcuma neilgherrensis* Wight.	1.6	9.20
4	*Curcuma scaposa* (Nimmo) Skornick. & M. Sabu	2.5	10.10
5	*Curcuma pseudomontana* J. Grahm.	2.0	12.30

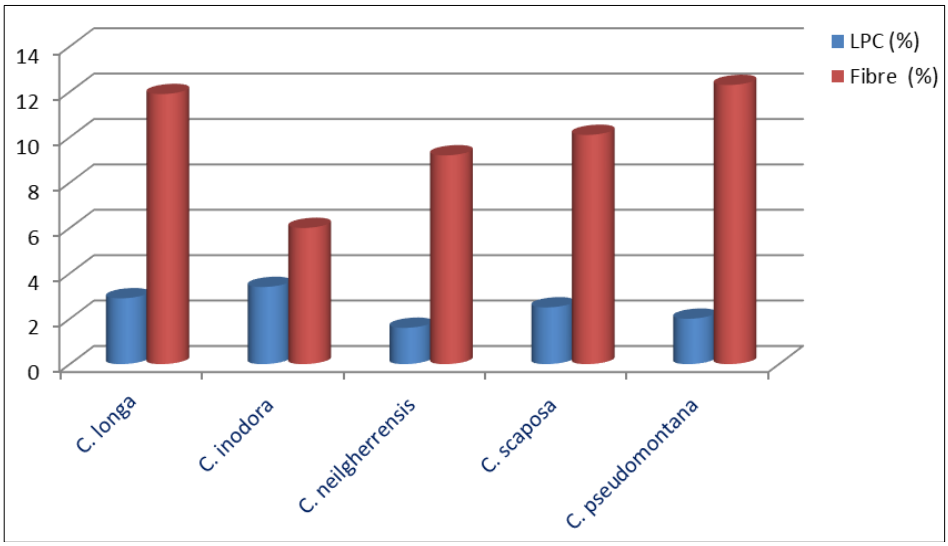

Fig 1: Leaf protein and fibre content in *Curcuma* species

Conclusion

The above experimental results clearly showed that, *Curcuma inodora* Blatt (3.4%) has high potentiality for providing leaf protein concentrate. followed by *Curcuma longa*, *Curcuma scaposa*, *Curcuma pseudomontana* and *Curcuma neilgherrensis.* Among most of Curcuma species, amount of leaf protein in *Curcuma pseudomontana* is about in the average. Thus, it is possible to use the Curcuma species leaf is a new protein. Whereas, highest percent fibre content was recorded in leaves of *Curcuma pseudomontana* (12.30%) followed by *Curcuma longa*, *C. scaposa*, *C. neilgherrensis* and *C. inodora* respectively

Acknowledgement
Authors are grateful to principal of Vivekanand Arts, Sardar Dalip Singh Commerce and Science College, Samarth Nagar, Aurangabad for providing laboratory facilities for the present research work.

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