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Orphan crops and nutrition: the potential of ricebean *(Vigna umbellata)* to reduce 'hidden hunger' among rural women in India and Nepal

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Introduction

Ricebean *(Vigna umbellata)* is one example of the 'underutilised crops' or 'orphan crops' that have received attention over the last decades due to the still narrower species and genetic base in the global food supply. Ricebean is native to the South and South East Asian region, primarily in hilly areas, and is for instance intercropped with maize. Ricebean is well suited to marginal and depleted soils and it has a favourable nutrient content. However, little crop development has been undertaken. There is no organised source of improved seeds and the production appears to be declining in most places. The preservation and utilisation of orphan crops is commonly argued with reference to their nutritional value and potentials to provide food security in general and in particular to reduce micronutrient disorders - 'hidden hunger'. These issues have also been a central part of the justification for the EU funded Inco-Dev project FOSRIN (Food Security through Ricebean research in India and Nepal; 6th Framework Programme contract 032055; http://www.ricebean.org). The nutritional value of the orphan crops and how they fit into existing diets is more assumed than evidenced. There is a substantial need for research which can document their actual role (TOLEDO AND BURLINGAME 2006). The purpose of this paper is to document the nutritional value of ricebean and analyse how it compares to existing nutritional problems among rural women.

Material and methods

Data on nutrient content of ricebean was compiled from published literature, for instance MOHAN AND JANARDHANAN 1994. For missing parameters (notably vitamins), analyses of two samples were done by the accredited laboratory EUROFINS. Comparison with other pulses was done by using the Standard Tables of Food Composition in Japan as it is available from the Sugiyama Database (http://database.food.sugiyama-u.ac.jp/index_asia.php). A review of the nutrient content was published in ANDERSEN 2007.

The major part of the data collection concerned the nutritional status of women of reproductive age in four study sites in rural areas in Himachal Pradesh and Assam in India, and middle Hill areas in West and East Nepal. The choice of these women was based on the assumption that this group may be particularly vulnerable to food insecurity and malnutrition. 800 women were

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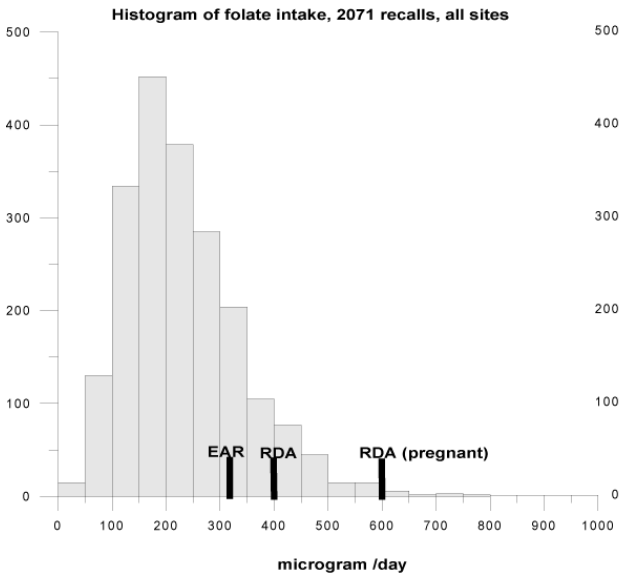
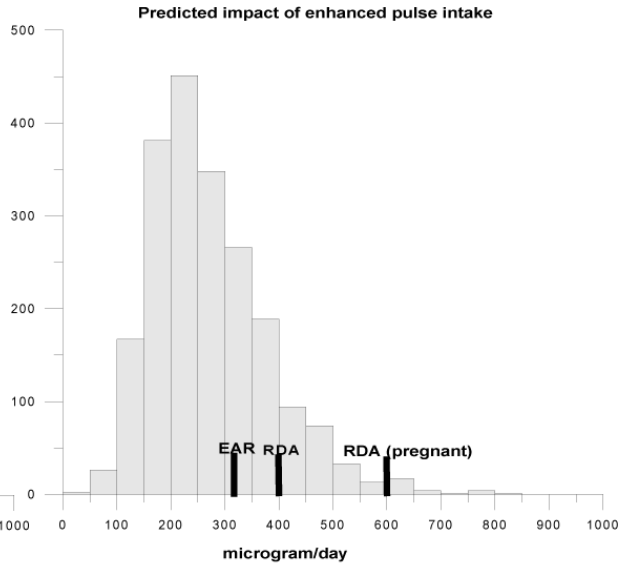
involved in a 24 hour dietary recall which was carried out three times to check for seasonality. The data were analysed using the WorldFood2 (WF2) computer programme. WF2 was developed under a project organised by United Nations University (UNU), named INFOODS, in cooperation with Univ. of California. WF2 is downloadable from http://www.fao.org/infoods/software_worldfood_en.stm . The intakes were computed and analysed in SPSS and compared to the NAS standards (NAS 2004).
Finally, the potential effect of adding an additional 30 grams of ricebean to the daily diet was calculated in order to simulate a realistic increase in pulse consumption if it were available at an unconstrained basis. This amount represents about a doubling of the pulse intake and was based on the statistics on availability of pulses per capita from pre-Green Revolution to present as well as field measurements of a 'full serving' of pulses.

Results and discussion
The nutrient content of ricebean was found to be comparable to other pulses. The protein content is showing considerable variation (literature quotes from 14 to 26 % but predominantly ricebean is in the lower range compared to other pulses). There seems to be agreement in the scientific literature that ricebean has a very favourable amino acid composition from a human consumption perspective, including a high lysine content. While the content of some B vitamins is slightly lower than in some other pulses, the mineral content is considerably higher, not least with respect to calcium (the best of all pulses), magnesium and potassium. Ricebean was found to be free from allergenic and toxic substances to any noticeable degree, and anti-nutritional factors such as trypsin inhibitor were found to be comparable to or lower than other pulses if prepared with soaking and cooking which is the local tradition. The content of phytic acid is around 2%, emphasising the importance of good preparation to avoid reduced bio-availability of iron, zinc and calcium in the diet.

The results from the dietary survey were analysed by ANDERSEN AND CHANDYO 2010. The diets in the four sampling sites had major similarities. Rice is the dominant staple food, providing about 64% of the total energy. An east-west gradient was found so that rice was nearly exclusive as staple in Assam while the Nepalese sites included a some more intake of maize and wheat, and wheat is consumed alongside with rice on a daily basis in Himachal Pradesh. The pulses were found to provide only 2.3% of the energy but a higher proportion of important nutrients. The women were largely living from vegetarian diets, although this was only a cultural choice in Himachal Pradesh; in other sites vegetarianism more involuntary. Dairy products provide about 2.6% of the energy but are important as a source of several micronutrients, not least vitamin B12 where it was found that 46% of the intake came from dairy products.

The mean intakes showed that micronutrient deficiencies were more widespread than PEM (Protein-Energy Malnutrition). Depending on pregnancy status, the women had on average intakes of protein that were close to the recommended values, and the energy requirements were largely met although physical activity levels were not taken into the calculations. As an indicator, the frequency of underweight (BMI < 18.5) women varied from 10.5% in Assam to 25.5% in Himachal Pradesh. Among amino acids, only lysine intake was found to be marginal. Major deficiencies of vitamin A, B12, C and D were found, but since these are hardly contained in pulse grains, they can not be met by strengthening the consumption of ricebean. Regarding other B vitamins, the mean intakes were close to recommended values for non-pregnant women, but considerable variation meant that substantial numbers were deficient. However, folate appears to be a major deficiency, especially for pregnant women. The diagram below is an example of how the calculated intake of folate compares to EAR (Estimated Average Requirements), RDA (Recommended Dietary Allowances) and RDA for pregnant women. The right hand side of the diagram shows the estimated impact of adding 30 grams of ricebean to the daily diet.





The most significant deficiencies of nutrients were found among minerals where especially potassium, calcium and iron were in very short supply. Although ricebean is a particularly good source of these minerals, any realistic increase in intake of pulses would not be enough to meet the requirements. The results of the calculations of potential impact of strengthening the daily intake of pulses by 30 grams of ricebean are presented in the table. The table contains selected nutrients where ricebean can be expected to make a difference.

	% of recalls above RDA/AI	% of recalls above RDA/AI with 30 g of ricebean added to daily intake
Protein[1]	50.4	66.6
Lysine[1]	56.7	75.8
Thiamin [1]	29.7	44.0
Riboflavin [1]	15.7	21.5
Niacin [1]	27.6	33.6
Pantotenic acid[2]	57.0	61.0
Pyridoxin [1]	55.5	59.2
Folate [1]	8.0	11.6
Potassium[2]	0.4	0.6
Calcium[2]	2.4	3.6
Iron [1]	8.6	12.6
Zinc [1]	49.8	68.4

Percentage of recalls above the recommended values. From ANDERSEN AND CHANDYO 2010. [1]RDA (Recommended Dietary Allowance according to NAS 2004) for non-pregnant women, [2]AI (Adequate Intake according to NAS 2004) for non-pregnant women.

The data on nutritive value must be seen as indicative since a substantial variation between different landraces and their nutrient content is likely to be found, and in addition it can be expected that soil nutrient parameters can affect the nutrient content. The literature on nutrient content of ricebean is typically based on a few accessions, and methodological differences may be at stake. Concerning the dietary recall studies, the measures were based on *food models* which were locally developed estimates using categories such as ‘small’, ‘medium’, ‘large’ and ‘very large’ bowls of food items. Although these were measured and weighed, some degree of rough approximation has emerged out of the approach.

Conclusions and outlook

Ricebean has a good amino acid composition and is rich in several minerals compared to other grain pulses. In particular ricebean could have a potential to reduce deficiencies of calcium, potassium and iron, in addition to folate. The theoretical impact of increasing the pulse intake was shown to have substantial impact on the intake of less severe nutrient deficiencies such as lysine, iron and some B vitamins. The nutrient value of ricebean should be compared to the nutritional problems that are found in the particular area. This study shows that protein-energy malnutrition is less severe than 'hidden hunger' in the four sites where dietary surveys were conducted. Some major problems that were forecasted were the vitamins A, B12, C and D. However, pulses do not have a potential to make an impact on these nutrient. When it comes to other B vitamins and minerals such as calcium, potassium, iron and zinc, ricebean and other pulses have a 'window of opportunity'. However, due to the severity of some deficiencies such as calcium and folate, a realistic amount of ricebean would not alone be enough to bring all women above the recommended intake of these nutrients. A general conclusion will be that ricebean as well as other orphan crops do have a substantial potential to add to the variety and nutritional value of local diets and thereby improve food security, but also that this should be compared to the totality of nutritional problems in an area. However, ricebean and other orphan crops offer also substantial other, indirect ecological benefits in terms of nitrogen fixation, animal fodder, erosion control and pest and drought resistance, so the total value of the marginal in the farming system and the food system is substantially larger than provision of single nutrients.

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