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STANDARDIZATION AND ORGANOLEPTIC EVALUATION OF SOUTH INDIAN RECIPES INCORPORATED WITH *TRIBULUS TERRESTRIS* (L) FRUIT POWDER

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ABSTRACT

The present days need for tasty but healthy foods pose a dilemma for consumers as well as the food industry. Healthy foods may be formulated with medicinal herbs, in order to make its consumption palatable and frequently consumable. In the present study an effort has been taken to incorporate Tribulus terrestris fruit powder in the black rice recipes and to evaluate them organoleptically by using 9 point hedonic scale. Tribulus terrestris fruit powder has been documented to treat various disorders namely urinary tract infections, sexual dysfunction, diabetes, lead toxicity, etc. Tribulus terrestris fruit powder has been incorporated at the rate of 10g, 20g and 30g. However, in comparison with the standard recipes, 10g Tribulus terrestris fruit powder recipes were found to be competent and acceptable. Particularly, Puttu recipe had the highest organoleptic score than the standard recipe. Thus the present study appreciably recommends aggressive inclusion and utilization of Tribulus terrestris fruit powder in the Indian recipe in order to alleviate the toxicity and complications that might occur due to the lead pollution as India is widely vulnerable to this heavy metal pollution.

Key Words: Tribulus terrestris fruit powder, Black Rice, South Indian Recipes, Organoleptic Evaluation

INTRODUCTION

Human's life is primarily affected by basic resources such as food that he eats and the environment that he lives. Diet varies with region and in the South East Asia, rice is the staple diet. Variety of rice varies with the region and nutritionally differs according to its species and nutrient composition. Some of the varieties also vary in their colour according to their pigments and antioxidants present. Itani & Ogawa, 2004 in their study mentioned that red rice has gained popularity in Japan as a functional food due to its high polyphenols and anthocyanin content. Similarly black rice has also been shown to possess nutritional advantages over common rice such as higher protein content, vitamins and minerals [Suzuki et al., 2004] or as an organic food colouring agent (Chaudhary, 2003).

Yet other grains and agricultural products are also consumed by Asian population. Apart from pesticides used by most of these agricultural countries, people also get exposed to industrial pollutants which mostly result in dreadful chronic toxicity. Similarly, the environmental exposure of certain chemicals could also bring in chronic toxicity. Lead is such one that is widely and commonly available toxic constituent across the World.

Lead is the major toxic heavy metal globally considered as number one environmental poison and health hazard affecting millions of people in all age groups (Thuppil Venkatesh., 2009). It is also one of the most abundant natural substances and is the fifth metal that is widely used throughout the world (Karrari *et al.*, 2012). It's easy availability and cost effectiveness made lead as an extremely popular component in the industrial revolution. However, its hazardous health effects were not considered at the time. Over the last few decades, with the adverse effects of lead coming to the forefront, nations across the world have started to recognize and treat lead toxicity (D'souza, 2011).

Inhalation and ingestion are the two most common routes of entry of lead into the body. Although ingestion is more common source, inhalation is the most significant as pulmonary absorption is efficient. Lead is absorbed in the blood plasma where it equilibrates with the extracellular fluid, crosses membranes such as the blood brain barrier and placenta, and accumulates in soft tissues and bones. Lead that is stored in bones can have a half life of up to 28 years and can be mobilized intermittently at times of stress, lactation or hormonal imbalances (Verity, 1990). Gastrointestinal ingestion is the most important source of lead intake in the body as lead does not have a feedback mechanism to inhibit its uptake (Sipos, 2003). Furthermore, dietary components, such as, sodium citrate, ascorbic acid, amino acids, vitamin D, proteins, fat and lactose can bind to lead and thus enhance the absorption of lead (DeMichele., 1984).

Lead is known to induce a broad range of physiological, biochemical, and behavioural dysfunctions in laboratory animals and humans (Flora *et al.,* 2006), including central and peripheral nervous systems (Bressler *et al.,* 1999), haemopoietic system (Lanphear *et al.,* 2000), cardiovascular system (Khalil- Manesh *et al.,* 1993), hepatic (Patra *et al.,* 2001) and male (Lancranjan *et al.,* 1975) and female reproductive systems (Ronis *et al.,* 1998). Such derangements are expected to occur at cellular level by increasing oxidative stress. Thus, lead is found to increase oxidative stress by the production of free radicals and decreasing antioxidant capacity resulting in cell apoptosis (Thuppil, 2014). In the past decades, after recognising the ill effect of lead exposure, scientific community has taken the challenge to resolve it and has been seeking strategies to overcome the toxicity in multiple ways including pharmacognosy. Various plants and their parts have been identified as detoxifiers and cell replishners worldwide.

Plant species play a very important role in the protection of kidney and liver as well as against cardiac disorders due to the presence of phytochemicals (Saurabh *et al.,* 2014). The medicinal properties of several herbal plants have been identified and documented in a number of ancient literature and the use of herbal plants have been found to be effective in the treatment of various diseases. The medicinal value of these plants lies in some chemical substances that produce a definite physiological action on the human body. The most important of these bioactive constituents of plants are alkaloids, tannins, flavonoids and phenolic compounds (Dorman *et al.,* 2000).

Such antioxidants are also present in many of the plants and their products. Tribulus terrestris a flowering plant of the Zygophyllaceae family, is The genus *Tribulus*, belonging to family Zygophyllaceae, comprises about 20 species in the world, of which three species, viz. *Tribulus cistoides*, *Tribulus terrestris*, and Tribulus alatus, are of common occurrence in India (Trease *et al.,* 2002). Among them, *T. terrestris* (TT) is a well-patronized medicinal herb by Ayurvedic seers as well as by modern herbalists and native to warm temperature and tropical region. It can thrive even in desert climates and poor soil (Duk et al., 2002). The plant is used individually as a single therapeutic agent or as a prime or subordinate component of many compound formulations and food supplements. It is an annual shrub found in Mediterranean, subtropical, and desert climate regions around the world, viz. India, China, southern USA, Mexico, Spain, and Bulgaria (Saurabh et al., 2014). However, this plant or its parts has been seldom tried as detoxifier or cell replenisher. Hence, an effort was put upon to explore the protective effect of TT fruit extract powder on the lead toxicity by Sasikala et al (2013), whose fairly successful results lead to a concept of incorporating this plant product into our common Indian recipes as otherwise this plant has only been used as Ayurvedic medicine (Sasikala *et al*, 2013).

Thus, in the present study rice has been used as the main ingredient to formulate recipes as Rice (*Oryza sativa*) is the major and staple cereal crop of over half of the world population. In China and India whose people constitute almost half the world's population, rice serves as the staple food for their daily life (Sasaki & Burr, 2000) and unsurprisingly, 95% of the world rice production is in Asian countries (Bhattacharjee *et al.,* 2002). Pigmented rice varieties are usually named according to their bran colour formed by deposition of anthocyanins in the pericarp, seed coat and aluerone (Chaundry, 2003). Pigmented rice is a potential source of antioxidants in various types of functional food production (Yawadio *et al.,* 2007). Potential antioxidative phytochemicals such as acetylated procyanidin, anthocyanins, and other phenolic acids, which can be found in this pigmented rice, can help prevent oxidative stress, inhibits the initiation and formation of cancer, reduces plasma cholesterol levels and may prevent cardiovascular disease (Romero, 2009). Therefore, this is yet another reason why black-purple rice was also selected to make recipes besides white rice.

Hence, both pigmented and white rice were used to formulate recipes using with Tribulus terresteris and thereby assessing their organoleptic properties. Also, ranking for their sensory evaluation has also been carried out.

OBJECTIVES OF THE STUDY

1. To formulate and standardize Indian recipes using *Tribulus terrestris.*
2. To carry out organoleptic evaluation of the same Indian recipes.

MATERIALS AND METHODS

DEVELOPMENT AND STANDARDIZATION OF SOUTH INDIAN RECIPES INCORPORATING TRIBULUS TERRESTRIS RECIPES

Two sets of south Indian recipes using white rice and Black Purple Rice (Kavanai Rice) were developed by incorporating *Tribulus Terrestris* (L) fruit powder at the proportion of 10%, 20% and 30%.

The recipes were repeated in human trials, altering the quantities of ingredients in definite proportions which produced similar results of the product. Thus, the recipes of the products desired were standardized.

SENSORY EVALUATION

The formulated recipes were subjected to sensory evaluation to test the acceptability using a nine point hedonic scale, where 9=liked extremely, 8=liked very much, 7=liked moderately, 6=liked slightly, 5=neither like or dislike, 4=disliked slightly, 3=disliked moderately, 2=disliked very much, 1=disliked extremely.

CRITERIA FOR SELECTION OF JUDGES FOR SENSORY EVALUATION

The following were the criteria for the selection of judges for the sensory evaluation

- Willingness to participate in the study

- With normal taste sensitivity-free from any oral problems that could affect taste
- Not allergic to the ingredients used in the formulation of the recipes
- Free from illness

Based on the criteria for selection mentioned above, thirty panel members with normal taste sensitivity and who were not allergic to the ingredients used in the recipes were chosen as judges for the sensory evaluation. The score card for the evaluation of the recipes was provided along with instructions to each judge before evaluation. Each member indicated the extent of their likes or dislikes in terms of colour, appearance, aroma, taste, overall acceptability. The sensory score of both white rice with *Tribulus terrestris* and black rice (kavani rice) with *Tribulus terrestris* for each parameter were subjected to statistical analysis to calculate mean scores.

PREPARATION OF TRIBULUS TERRESTRIS (L) FRUIT POWDER

The healthy plant samples of *Tribulus terrestris* (L) plant were collected from Coimbatore District Tamil Nadu, India. The plant material was authenticated by a skilled taxonomist at Botanical Survey of India and a voucher specimen [NO: BSI/SRC/5/23/2013-2014/TECH/1024] was deposited at the Tamil Nadu Agricultural University, Coimbatore. The fresh fruits of *Tribulus terrestris* (L) was collected and were dried in the shade, powdered and stored in a sterile and in a tight container for further use, which was later incorporated into white and black rice (kavani rice) formulations.

RECIPE FORMULATION

Seven recipes namely idly, dosa, puttu, kolukattai, idiyappam, adai, uppma were formulated, standardised and supplemented with *Tribulus terrestris* fruit powder at the rate of 10, 20 and 30 grams as variations. However a standard recipe using only black rice or white rice were also formulated and standardised. In fact, this was considered as normal standard recipe which were then compared with the test recipes with their selected sensory attributes, namely colour, appearance, aroma, taste and overall acceptability.

RECIPES PREPARED WITH DIFFERENT METHODS OF COOKING BY INCORPORATING TRIBULUS TERRESTRIS INTO WHITE AND BLACK RICE

FOOD PREPARATIONS	METHOD OF PROCESSING
Adai	Steaming
Kolukattai	Steaming
Idiyappam	Steaming
Idly	Steaming
Dosa	Roasting
Puttu	Steaming
Uppma	Boiling & Seasoning

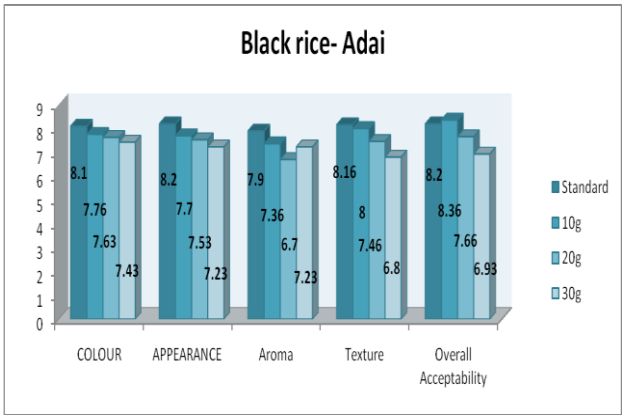
STATISTICAL ANALYSIS

GARRETT'S RANKING

Garrett's test has been used to analyse the factors influencing the preferences of the respondents for the overall acceptability of Indian recipes prepared with black rice and white rice with the addition of *Tribulus terrestris* fruit powder. Under the garretts' ranking technique average score is calculated by multiplying the number of respondents ranking that factors as 9,8,7,6,5,4,3,2,1 by their respective table values given. Mean score is calculated by dividing average score by number of respondents. The respondents were asked to rank the five factors identified for the purpose of the study as 1, 2,3,4,5. Rank 1 is the highest percentage position whereas rank 5 is the least percentage position. It is said that according to Garretts' ranking the factors which induces respondents to show preferences of various recipes in different proportions are namely colour, appearance, aroma, taste, overall acceptability. Garrett's' ranking technique is to find out the most significant factor which influences the respondent.

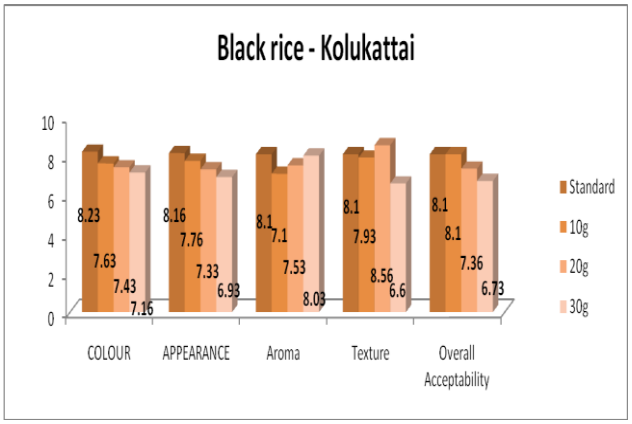
RESULTS

MEAN 9 POINT HEDONIC SCALE SCORES OF BLACK RICE ADAI



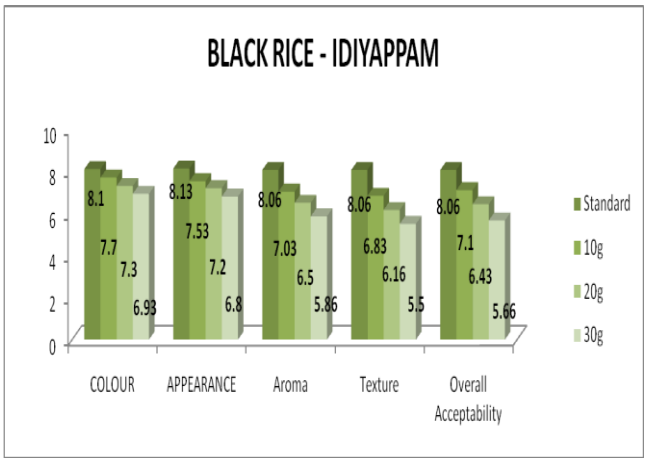
With reference to the criteria colour that was analysed by 9 hedonic scales, it is clearly evident that the standard recipes without the inclusion of Tribulus terrestris fruit powder had the highest mean value of 8.1. Similarly with the criteria "Appearance" the standard recipe scored the top with the mean value of 8.2. In the same way the other two criteria namely aroma and texture also favoured only the standard recipes. However, the test recipe including 10g of Tribulus terrestris fruit powder scored highest of 8.36 than the standard and other two variation (20 and 30%). From the above assessment it may be implicated that the standard as well as the test recipes did not have much difference criteria wise as they were prepared out of black rice.

MEAN 9 POINT HEDONIC SCALE SCORES OF BLACK RICE KOLUKATTAI



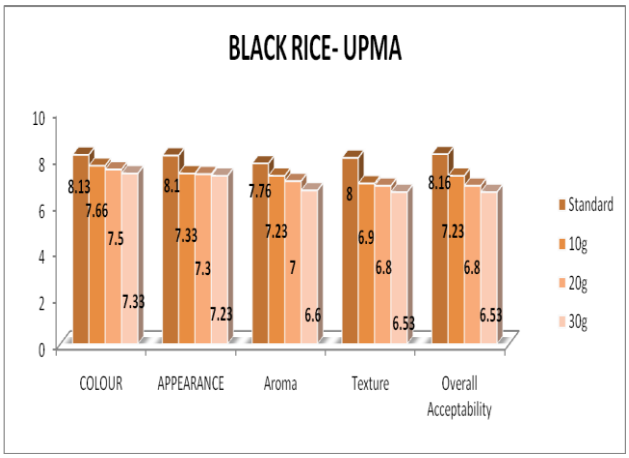
With regard to the characters of colour, Appearance, Aroma, Texture and Overall acceptability of black rice kolukattai, the standard recipe had the highest score in comparison with the other three proportions namely 10g, 20g, 30g. Followed by this, the test recipe black rice kolukattai with 20g of Tribulus terrestris fruit powder stood next to the standard recipe in terms of all the characteristics of sensory evaluation assessed.

MEAN 9 POINT HEDONIC SCALE SCORES OF BLACK RICE IDIYAPPAM



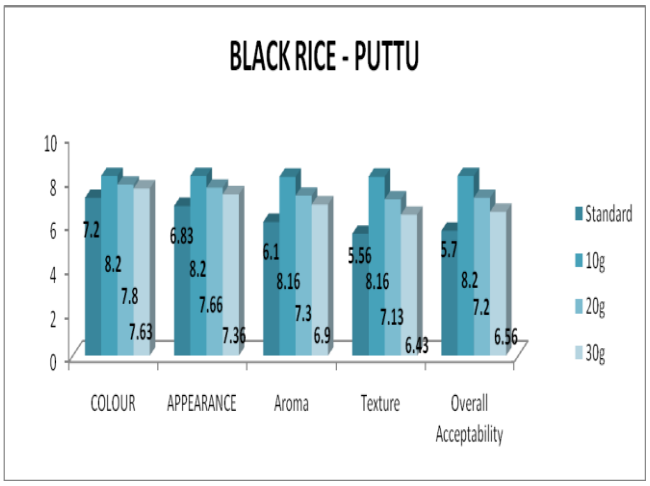
The criteria of sensory evaluation with regard to idiyappam black rice, as usual standard recipe had the highest score and that of inclusion of 30g of Tribulus terrestris fruit powder had the lowest score. However by all criteria of organoleptic evaluation of black rice idiyappam with 10gm of Tribulus terrestris fruit powder had a mean score next to that of standard recipe which is imperative that inclusion of 10gm of Tribulus terrestris fruit powder to the standard black rice idiyappam is also comparatively accepatable.

MEAN 9 POINT HEDONIC SCALE SCORES OF BLACK RICE UPMA



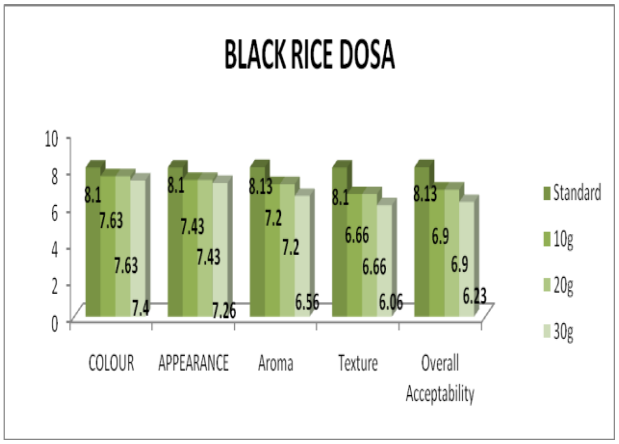
When compared with standard black rice upma, the colour, appearance, aroma and texture of the black rice upma incorporated with 10g of Tribulus terrestris fruit powder scores next(second) to the standard recipe followed by black rice upma 20gm and 30gm. Similarly, the overall acceptability of black rice upma with 10gm Tribulus terrestris fruit powder is competent with the standard recipe.

MEAN 9 POINT HEDONIC SCALE SCORES OF BLACK RICE PUTTU



Unpredictably the black rice puttu incorporated with 10g Tribulus terrestris fruit powder scored higher than the standard recipes in terms of colour, appearance, aroma, texture and overall acceptability. Similarly even the black rice puttu recipe added with 20gm and 30gm of Tribulus terrestris fruit powder respectively scored next to recipe with 10gm of Tribulus terrestris fruit powder but scored more than the standard recipe.

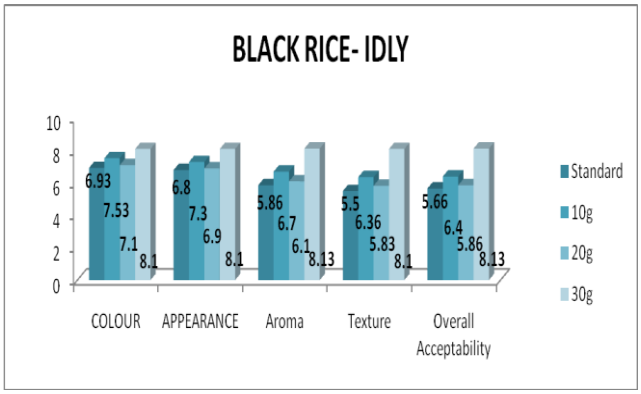
MEAN 9 POINT HEDONIC SCALE SCORES OF BLACK RICE DOSA



When black rice dosa was analysed with 9 point hedonic scale, the sensory characteristics like colour, appearance, aroma and texture were high for the standard recipe. However, with this recipe, the black rice dosa added with 10g and 20 g Tribulus terrestris fruit powder scored equally in all the sensory criteria. Even over all acceptability of these two recipes were similar in their scores only black rice dosa incorporated with 30g of Tribulus terrestris fruit powder scored the least in all the organoleptic characteristics.

Black rice dosa recipe and black rice puttu recipe added with Tribulus terrestris fruit powder 10g and 20g almost compete with the standard.

MEAN 9 POINT HEDONIC SCALE SCORES OF BLACK RICE IDLY



When compared with other recipes, the organoleptic characteristics of black rice Idly prepared with 30 g of Tribulus terrestris fruit powder scored highest in comparison with the other two proportions and the standard recipe too. Ultimately, may be the expected characteristics of the idly as it was not met with, probably the standard black rice idly itself had the least score. However, black rice idly added with 10g of Tribulus terrestris fruit powder scored next to the same recipe added with 30g of Tribulus terrestris fruit powder. So other than the ingredients of recipe, the method of processing may also influence organoleptic or quality characteristics. Thus, idly as it is steamed and is expected to have a soft pancake like quality. Plausibly as the black rice was used for making idly would have unfavourably influenced the quality characteristics and the perception of judges.

DISCUSSION

Incorporating herbs to the regular food stuffs make it value added products. However, the proportion of incorporation of the herbs depends on the nutrient, aroma and taste profile. In a study conducted by Mohammed et al (2014), the fiber enriched herbal biscuits were greatly acceptable only with the addition of Tulsi and Moringa leaves at 1% level. However in the present study we have tried the incorporation of Tribulus terrestris fruit powder at the rate of 10g, 20g, 30g respectively. Among these proportions, with reference to most of the organoleptic attributes, the standard recipe and the recipe added with 10g of Tribulus terrestris fruit powder were highly acceptable. Such a inference has been obtained out of our sensory evaluation using 9 point hedonic scale.

However in another study conducted by Vanisha *et al* (2008) found that inclusion of 20g of moringa leaves into Traditional Indian recipes like Mung (Phaseolus aureus), Kabuli channa (Cicer arietinum) and desi channa (Cicer arietinum) were highly acceptable on 5 point hedonic scale. As moringa leaves commonly used in Indian cuisine and as it does not provide any unacceptable flavour or taste attributes, thus could have influenced its high acceptability, whereas the Tribulus terrestris fruit powder as analysed, too did not give any unaccepatable quality characteristics to the recipe made with it even at the rate of 20g of Tribulus terrestris fruit powder. However, addition of 10g of Tribulus terrestris fruit powder to the black rice recipe was highly accepatable.

Such promotion of Tribulus terrestris fruit powder incorporation into the diet in India and also in other countries could go a long way towards not only alleviating lead pollution but may also be helpful in various other conditions like urinary tract infection, diabetes, sexual dysfunction and even in adriamycin induced cardio toxicity.

The present study appreciably recommends the prospect of more aggressive inclusion and utilisation of Tribulus terrestris fruit powder in the Indian recipe in order to alleviate the toxicity and complications that might occur due to the lead pollution as India is widely vulnerable to this heavy metal pollution.

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