FORTIFICATION OF TRADITIONAL RECIPES WITH ANTIOXIDANT ABUNDANT FOOD STUFFS AND THEIR ACCEPTABILITY EVALUATION

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Summary

The present study is illustrative examples of establishing the quantitative abundance of health enhancing antioxidants in plant based foodstuffs that are abound in the *environment*. It becomes imperative to explore and investigate plant based food stuffs in a more focused and systematic manner in the wake of increasing occurrence of phenomenon of free radicals built up due to the disturbance in the normal steady state cycle of *milieu anterior* in the human beings. Endogenous oxidative metabolism, in combination with effects of environmental radiations and pollutants, cause oxidative stress of free radical origin which eventually snowball into chronic and degenerative diseases such as *cardiovascular (CVD)*, certain types of *cancer and diabetes mellitus.* The study comprised choosing different plant based food stuffs from various food groups and appraising their antioxidant potential quantitatively by estimating antioxidant markers in each one of them. Whereas food groups of foodstuffs explored for antioxidant appraisal have *vegetables, fruits, spices and condiments*, the antioxidant markers taken up for qualitative analysis included *thiol content (reducing power), vitamin C* (L - Ascorbic Acid), *tannins and polyphenols*. The results pointed towards the presence of antioxidants, both in content and kind, invariably in food stuffs belonging to food groups of various types making them qualify for *functional foods*. As a number of factors contribute in making up the cultural, life style and dietary choices of population groups, certain traditional recipes were improvised through their *blending* with the respective plant based food stuff offering compatibility. Two food stuffs each were selected from three important food groups, viz. pomegranate (*Punica granatum*) and green grapes (*Vitis vinifera*) from fruits, bathua (*Chenopodium album*) and tomatoes (*Solanum lycopersicum*) from vegetables, and ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*) from spices and condiments. The recipes selected for their improvisation included *pulao, lassi, chutney, raita, fruit punch and squash.* The recipes were standardized both in their native as well as improvised forms and acceptability rating undertaken using sensory evaluation procedure. Traditional and non-conventional foods stuffs of plant origin occurring or grown through *environmentally sustainable* means are likely to be the stuff of nutrition research and dietary choice in the near future.

Keywords: Phytochemicals, thiol content (Reducing power), tannins, polyphenols, antioxidants, fruits and vegetables

Introduction

Whereas earlier reflections on the healthy, wholesome diet used to consider proteins, vitamins, and minerals the only protective agents against the chronic diseases however, now-a-days phytochemicals- the bio-active chemically derived compounds ubiquitous in the food stuffs, have made their presence felt by becoming one of the most investigated issues of nutritional interest. The health potential of phytochemicals that helps to combat oxidative stress, the root cause of many non-communicable diseases is inherent in their anti-oxidative properties. Oxidative stress causes the cellular dysfunction via the accumulation of oxidized macromolecules, damaged cell structures, altered gene expression and enzyme activities and eventually culminates in increased predisposition to chronic diseases. Such oxidative lethality further aggravates the production and accumulation of reactive oxygen and nitrogen species leading to the more destructive diseases like neurodegeneration, mitochondrial dysfunction and inflammatory cascade. In this context, antioxidants are paramount as protective agents due to their primary reaction with free radicals which thus halt the initial trigger associated with the pathophysiology of several diseases including cancer, cardiovascular diseases and neurodegeneration. Furthermore, body's antioxidant machinery declines with the ageing process. Thus dietary supply of antioxidants is profoundly crucial to the existing antioxidant defense either by providing redox active compounds that can directly scavenge or neutralize free radicals or other reactive oxygen (superoxide, hydroxyl radicals) and nitrogen species (peroxynitrite), or by providing compounds that can induce the gene expression of the endogenous antioxidants.

Vitamin E, ascorbate and carotene present in grains, fruits and vegetables, and nuts are the most known antioxidants which have robustly proved their significance in health promotion and disease prevention. Other emerging compounds of prolific antioxidant potential are phytochemicals and polyphenols present in many edible plant foods from different food groups but in varying concentrations. Phytochemicals involve phytoestrogens (phytosterols, phytostanols and lignans) present in whole grains, pulses, nuts and oilseeds and carotenoids, terpenoids, glucosinolates, sulphur-contaning compounds present in fruits and vegetables. Polyphenols is a broad cateogory consisting of phenolic acids, flavonoids, stillbenes etc out of which flavonoids forms a widely studied subgroup because of their enormous presence in fruits, vegetables and pulses and their better bio-availability or inefficiency of the digestive enzymes in the human gut, yet exert the positive health effects resulting from their concurrent liberation from the dietary fibre in the colonic region [1]. Various studies have reported the abortive effects of single-nutrient supplementation in treating the chronic diseases like cancer pin-pointing that the best protection against diseases is provided by a cocktail of nutrient and non-nutrient, bio-active antioxidants.

Various food groups consisting of whole grains, pulses, fruits and vegetables, nuts and oilseeds possess a strong antioxidant activity due to a presence of both macronutrient and micronutrient antioxidants supported profoundly by a wide range of phytochemicals and polyphenols depicting their biological significance as potential antioxidants [2].

The WHO has recommended the daily consumption of at least 400g of fruits and vegetables. The high content of polyphenol antioxidants in

fruits and vegetables is probably the single main factor responsible for these effects (3, 4).
As a matter of fact, diets based on plant foods will provide a mileu of phytochemicals, the non nutritive substances in plants that possess health protective effects. Fruits and vegetables provide the best polypharmacy against development of chronic diseases considering that they contain vast array of antioxidant components (5).

Materials and Methods

The study was carried out in three phases, phase I comprised of the selection of two foodstuffs from three important food groups i.e. pomegranate and green grapes from fruits, bathua and tomatoes from vegetables and ginger and turmeric from spices and condiments.500g of each foodstuff was dried and were processed to powder form. *Moisture contents* of various food stuffs analyzed for antioxidant activity in native and reduced moisture states, as estimated for each form has been as under.
*Fresh Pomegranate - 78%, Dry Pomegranate -54.3%, Fresh Green grapes - 79.2 %, Dry Green grapes - 51.2%, Fresh Tomato - 93.1 %, Dry Tomato - 53%, Fresh Bathua - 89.6%, Dry Bathua – 60.9%, Fresh Ginger - 80.9%, Dry Ginger - 48.7%, Fresh Turmeric - 13.1%, Dry Turmeric - 9.3%

Accordingly, the food stuff in native form with higher moisture level was termed as *fresh* and in the partially dried form with reduced moisture level as *dry*. The pomegranate, green grapes and tomatoes, due to their moisture content, did not dry completely even after oven drying and were followed by calculating the moisture content. Phase II involved the preparation of extracts from both fresh and dried samples. Pomegranate and tomato extracts were prepared by the method of Rani et al. (6), for bathua, turmeric extract by Haque et al. (7) and for ginger by Mendiratta et al(8). Thereafter, the active antioxidants in each food stuff, thiol content (reducing power) (9); polyphenols (10); Vitamin C (11) and tannins (12) were estimated. Phase III involved the product development and sensory evaluation. Six recipes (Lassi; Fruit punch; Squash; Pulao; Chutney and Raita) were prepared, one standard and three test recipes by incorporating these foodstuffs in the concentrations 20%, 30% and 40% respectively. Sensory evaluation of the products was carried out by 9-point hedonic rating scale which included scoring for overall acceptability of the food products (13).

Statistical Analysis:
All values have been presented as mean± SD.

Results and Discussion

Epidemiologicalstudies show that many phytonutrients of fruits and vegetables may be beneficial to protecting the human body against damage by reactive oxygen and nitrogen species (14, 15). However, epidemiological etiological methods do not readily reveal which compounds in these food groups are responsible for these health benefits; indeed, compounds potentially responsible include vitamins and minerals, soluble and insoluble fibers and phytochemicals. Thus the present study was undertaken to know about the antioxidants present in the foodstuff, their activity and the potential application in nutrition.

Thiol content (Reducing power)

Among the fresh sample the content of thiol content (reducing power) was found to be maximum in ginger (2.9g/100g) followed by turmeric and tomato i.e.706mg/100g and 332mg/100g respectively as shown in table I. Fruits were found to be low in thiol content (reducing power) in comparison to vegetables and spices. In dried samples, there was reduction in the antioxidant enzyme (Table I). However, bathua leaves showed substantial quantity of the enzyme even in dried form. Among the dried forms ginger had the maximum (468mg/100g) followed by tomato. Dried samples of fruits too, lagged behind in the thiol content (reducing power), in comparison to dried vegetables, spices and condiments.

Vitamin C

Among the fresh samples, maximum Vit C content was found in Bathua leaves i.e. 56mg/100g followed by tomato; spices and condiments were found to possess the least Vit C content.

In the dried samples, there was reduction in Vitamin C content, except green grapes and ginger in which the content remained the same as in fresh samples (Table I). Some studies show that supplemental vitamin C intake lowered blood pressure (16, 17)

Polyphenols

Among the fresh samples, maximum polyphenols were present in turmeric (166.7mg/100g) followed by tomato and ginger. Fruits lagged behind, in polyphenol content among the three selected food groups.The polyphenol content was found to be increased in dried samples of all the selected foodstuffs except in pomegranate which showed a decrease in polyphenol content (Table I). Natural polyphenols have chain-bracking antioxidant activities and are believed to present many degenerative diseases, including cancer and atherosclerosis (18).

Table I Antioxidants content in fresh & dried samples of selected foodstuffs

Name of the foodstuff	Thiol content (reducing power) (mg/100g)	Vitamin C (mg/100g)	Polyphenol (mg/100g)	Tannin (mg/100g)
FRUITS				
Pomegranate				
(Fresh)	78.8	7.0	7.5	215.0
(Dry)	52.9	1.6	5.3	1.9
Green grapes				
(Fresh)	28.0	8.5	7.7	163.0
(Dry)	12.9	8.5	45.0	112
VEGETABLES				
Tomato				
(Fresh)	332.0	56.0	16.9	311.0
(Dry)	238.0	2.1	74.7	2143.9
Bathua				
(Fresh)	114.0	23.7	36.5	72.5
(Dry)	144.0	2.4	40.5	486.0
SPICES & CONDIMENTS				
Ginger				
(Fresh)	2983.0	6.7	23.9	384.4
(Dry)	468.0	6.7	152.2	1083.3
Turmeric				
(Fresh)	706.0	5.3	166.7	856.0
(Dry)	-	-	-	-

Tannins

Turmeric was found to contain the maximum tannin content (856mg/100g) followed by ginger in fresh samples. Tomato was found to have minimum tannin content (72.58mg/100g). Tannins were found to decrease in dried fruit samples. However, their content increased in dried samples of vegetables, spices and condiments as evident from table I.

Product Development & Sensory Evaluation

All the recipes scored almost equal as standard in overall acceptability and other attributes as well and thus are potentially acceptable (Table II).

Table II Over all acceptability evaluation of food products based on 9 point hedonic method

Food Products	Group -S	Group -A	Group -B	Group –C
Lassi	7.53±0.9	7.20±1.0	7.40±1.2	7.13±1.2
Fruit punch	7.4±1.0	7.40±0.7	7.7±0.9	7.26±0.9
Squash	8.26±1.0	8.13±0.8	8.13±0.8	8.26±0.8
Pulao	8.4±0.6	8.20±0.7	7.93±0.9	7.60±1.0
Chutney	8.46±0.7	7.80±1.1	6.60±1.6	6.00±1.9
Raita	8.00±0.6	7.20±1.0	6.4±1.3	6.13±1.0

Values are Mean ±SD for groups of 15 semi-trained panelists.

Standard of lassi was most acceptable among all. Among versions group B was most acceptable. It was followed by group A. Group C was the least acceptable. In case of fruit punch, group was even better than standard. It was followed by standard and group A. Group C was the least acceptable. Standard and group C got high mean scores than group A and B which were equally acceptable. Standard was most acceptable in terms of pulao. While group A got more mean scores than group B and C. Group A was most acceptable among all versions in terms of chutney. Group B was more acceptable than group C. Standard stood out. Group A got higher mean scores than group B and C. But standard was best among all.

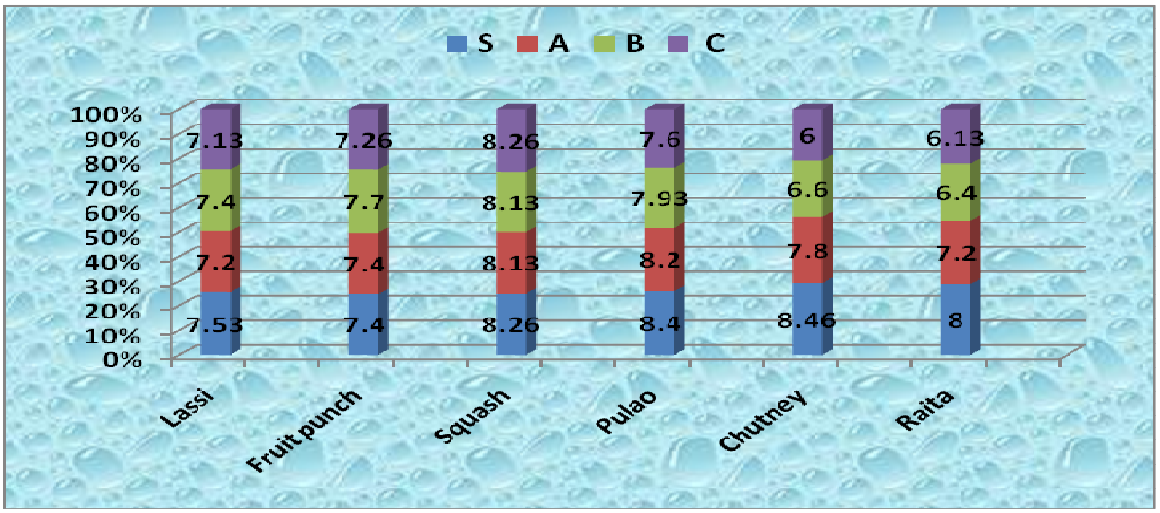

Fig. 1: Over all acceptability evaluation of food products based on 9 point hedonic method

Lassi, Fruit punch & Squash

Group –S Standard Recipe
Group –A Test Recipe + 20% pomegranate & green grapes
Group –B Test Recipe + 30% pomegranate & green grapes
Group –C Test Recipe + 40% pomegranate & green grapes

Pulao, Chutney & Raita

Group –S Standard Recipe
Group –A Test Recipe + 20% Tomato & ginger
Group –B Test Recipe + 30% Tomato & ginger
Group –C Test Recipe + 40% Tomato & ginger

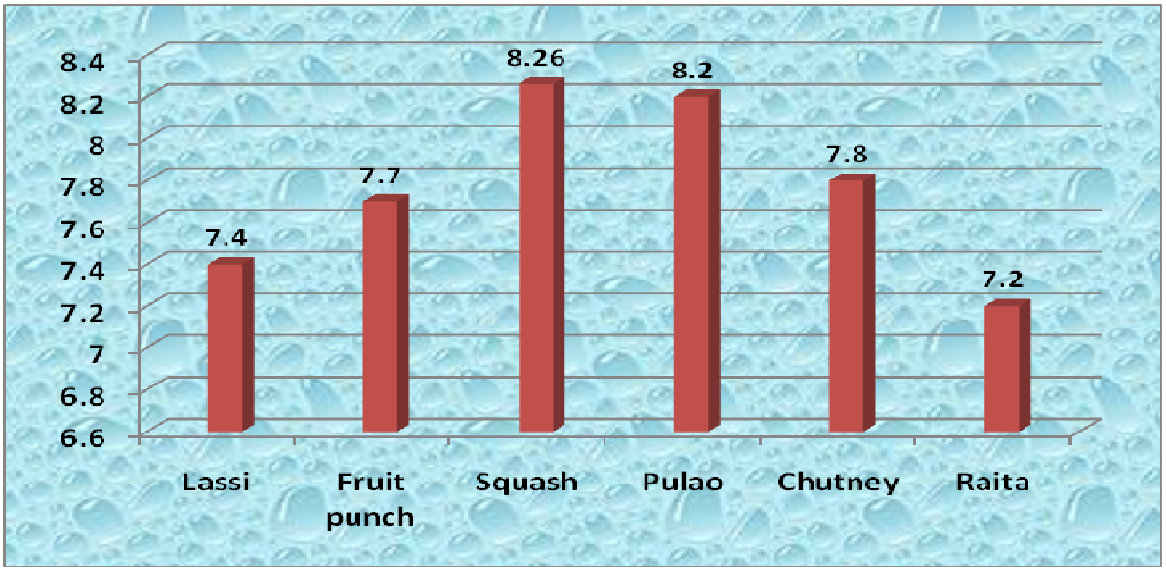

Fig. 2: Acceptability evaluation of all recipes

Fig 2 reveals that among all recipes squash was most acceptable. Next place was given to pulao. It was followed by chutney. Fruit punch was next choice. Raita was placed next to lassi.

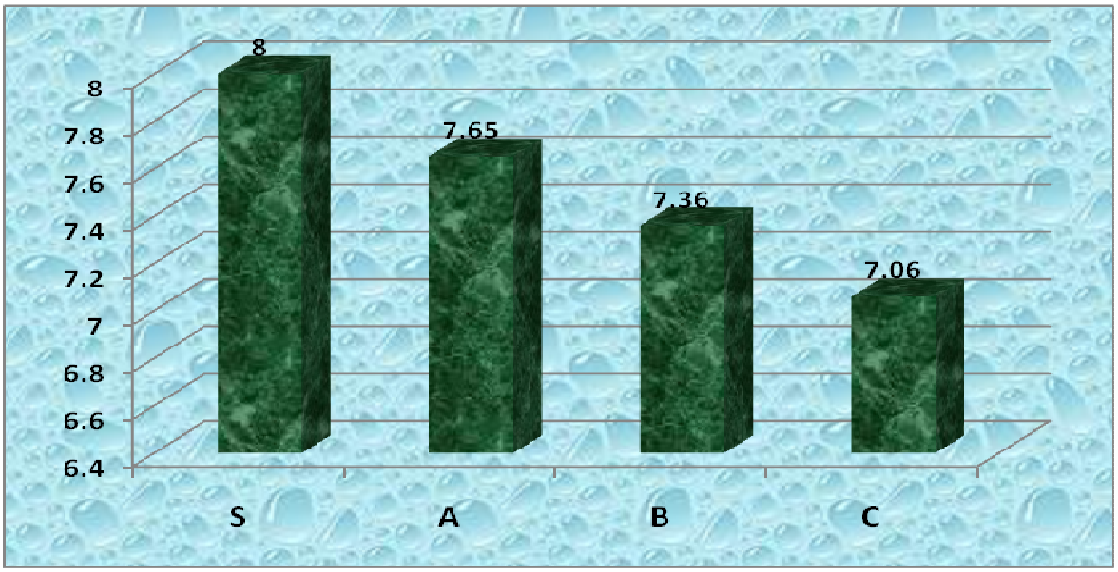

Fig 3: Acceptability evaluation of all versions

This figure demonstrates that standard was most acceptable among all. It was followed by group A, B and C.

Conclusions

The present endeavor has been a small stride in evaluating the antioxidant potential of selected foodstuffs so that they could be of utmost use in overcoming the expanding frontiers of degenerative diseases and curbing the onset or progression of degenerative signs of aging, atherosclerosis, cancer, diabetes mellitus. In essence, following conclusions can be drawn from this study.

- Earlier reflections on the healthy, wholesome diet used to consider proteins, vitamins, and minerals the only protective agents against the chronic diseases.
- However, in a paradigm expansion, phytochemicals - the chemically derived bio-active compounds, ubiquitous in the food stuffs, have become one of the most investigated issues of nutritional interest now as would become evident from the outcome of this small study.
- The various test recipes enriched by extracts from the respective food stuffs appraised for antioxidants at different conc. levels scored fairly well vis-à-vis their standard counterparts indicating no acceptability constraints in such antioxidants enriching recipe improvisations

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