

# Research Reach

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Research Unit  
College of Home Science  
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# **RESEARCH REACH - JOURNAL OF HOME SCIENCE**

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# RESEARCH REACH

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**ANTIOXIDANT AND ERGOGENIC HERBAL SUPPLEMENTS***Geetanjali Kelkar and Subhadra K*

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Herbs have been used time immemorial for their medicinal and ergogenic properties. Adaptogenic properties of herbs normalize body functions altered by physical, physiological and psychological stress. The varied chemical constituents and complex structure are responsible for their multiple therapeutic and ergogenic effects. Herbs are now found to possess antioxidant properties and stimulate the production of antioxidant enzymes, chelate metals and combat ROS (reactive oxygen species). This ability is also responsible for their therapeutic and ergogenic benefits. The antioxidant effects of Withanolides (Ashwagandha), Ginsenosides (Ginseng), EGb 761 (Ginkgo biloba) and Curcumin (Turmeric) are well comparable with well-known antioxidants alpha tocopherol, retinol acetate,  $\beta$  Carotene. The ergogenic and antioxidant properties of these herbs have been reviewed in the present article.

**KEY WORDS:** adaptogenic, antioxidants, ergogenic, free radicals, herbal supplements, Therapeutic

Oxygen is one of the most essential elements for life, without which, survival is impossible. Yet paradoxically, oxygen is also involved in toxic reactions and is therefore a constant threat to the well being of all living things. Most of the potentially harmful effects of oxygen are due to the formation and activity of reactive oxygen species (ROS) acting as oxidants, the compounds with a tendency to donate oxygen to other substances. Many reactive oxygen species are free radicals (Langseth 1985).

A free radical is defined as a molecule with one or more unpaired electrons in an orbital (Halliwell 1987). Free radicals attack cellular components, damage carbohydrate, protein, lipids and nucleic acids. The reactive oxygen species are produced constantly in the body and cause degenerative diseases.

Exercise appears to increase production of reactive oxygen species that can damage the cells. Oxygen consumption increases during exercise and causes an increase in free radical production and thereby lipid peroxidation. It generates free radicals due to certain exercise induced biochemical changes in the body such as (i) an increase in the production of epinephrine and other catecholamines; (ii) an increase in the production of lactic acid that can convert a weakly damaging free radical (superoxide) to a more damaging one (hydroxyl) and (iii) inflammatory responses to secondary muscle damage incurred with overexertion and transient hypoxia. Reoxygenation also promotes free radical formation (Clarkson 1995; Ji 1995; Sen 1995; Narasinga Rao 1996; Kanter 1998).

The human body contains an elaborate antioxidant defense system that depends

on the endogenous production of antioxidant enzymes like glutathione peroxidase (GSSH), superoxide dismutase (SOD), catalases (CAT) and glutathione reductase (GSH). The exogenous defense is the dietary consumption of antioxidant vitamins and minerals that efficiently neutralize the effect of free radicals and protect the body against damaging effects (Demopoulos et al. 1984). Exercise is a form of stress due to which increased amounts of malondialdehyde and pentane are produced in the body and excreted in breath; both serve as indicators of lipid peroxidation. To reduce the extent of damage due to exercise, trained athletes are given antioxidant supplements that show evidence of reduced oxidative stress (Clarkson and Thompson 2000).

Supplements are consumed for their preventive, protective and curative effects along with the other medical and dietary treatments. Major supplementation trials with supplementation of Vitamin C,  $\beta$  Carotene, Vitamin E, and Zinc have been widely studied. The trials with antioxidant nutrients or derivatives have already been documented and are in the 'pipeline' which might appear as registered pharmaceuticals 5 to 10 years from now (Block and Langseth 1994; Manson et al. 1995). Antioxidant vitamins and minerals might dominate the pharmaceutical industry in future. The consumption of such supplements amongst the normal as well as athletic population has reached astonishing proportions.

### **Herbal supplements**

Consumers have wide access to a variety of supplements. Apart from dietary supplements the market is flooded with supplements classified as nutraceuticals, botanical supplements, herbals and ergogenic aids and medicinal foods. These diverse names are familiar to consumers due to high level of marketing strategies of companies (Marriott 2000). Herbs and herbal preparations now dominate the market of supplements and their availability and usage has increased tremendously especially among athletic population. This is because herbs are 'natural' and claimed to be safe, but scientific scrutiny with controlled clinical trials should be mandatory before advocating their consumption by athletes (Bucci 2000).

Herbs are defined as plant or plant extracts ingested for other than caloric or culinary benefits (Bucci 2000). The herbs and herbal preparations originate from the ancient Ayurvedic and Chinese systems of medicines. Herbs with medicinal properties have been used from time immemorial in all cultures and form the foundation of modern western pharmacology (Goldman 2001).

Herbs are classified as adaptogens. Adaptogenic herbs are botanical substances that help the body to adapt to physiological stress. They assist normalization of body functions altered by stress rather than exerting a stimulatory effect (Nadkarni 1976; Sharma 1976; Kleijnen and Knipschild 1992). Persons who exercise use adaptogens because exercise is considered to be a form of stress. Various commonly used combinations of traditional Chinese and Indian herbs are adaptogens. The Chinese medicine stresses restoration of Qi or life energy (Bensky and Barolet 1990). The ayurvedic system of medicine is termed as Designer Medicine and the ancient knowledge if put to the test of modern science will lead to emergence of the Future Modern Science (Patwardhan 2000).



Herbs have largely been used for their therapeutic benefits. But apart from their therapeutic benefits many herbs/plant foods have well documented antioxidant activities in humans as indicated in Table 1. The antioxidant effect of plant foods is attributed to the presence of phytochemicals. Whether these activities would affect human physical performance needs to be explored.

**Table 1. Selected Herbs/ Foods with Antioxidant Properties**

Herb/ plant food	Antioxidant compound
Citrus and other fruits	Bioflavonoids, chalcones
Coffee	Phenolic esters
Garlic	Glutathione, sulfhydryls, selenium
Grape skin and seeds	Procyanidins and resveratrol
Green tea, black tea	Polyphenols, catechins
Green vegetables and marigold flowers	Lutein
Olives	Polyphenols
Onions	Quercetin, kaempferol
Red wine	Phenolic acid
Rosemary, sage and other spices	Carnosic acid, rosmarinic acid
Soybeans	Isoflavones, phenolic acids
Tomatoes	Lycopene
Turmeric	Curcumin

Source: Langseth 1985 and Bucci 2000

There are a number of herbal supplements used for their therapeutic, adaptogenic and ergogenic benefits. These supplements are found to be potent antioxidants. The herbal supplements are different from the synthetic supplements because of their multiple effects and benefits. These effects are due to their complex chemical structure and composition. The present review explores the therapeutic (Table 2), ergogenic and antioxidant effects (Table 3) of selected herbal supplements.

#### Ashwagandha (*Withania Somnifera*) Indian Ginseng:

Ashwagandha (*Withania somnifera*) known as Winter Cherry has been used for thousands of years as a popular medicine in Ayurveda. It is one of the best known and researched Ayurvedic herb. Its therapeutic potential is similar to Ginseng in Chinese therapies (Patwardhan et al. 1988; Aphale et al. 1998) and is also used in Unani systems of medicine (Sharma et al 1985). It is a medicine used to "balance life forces" mentioned in Vedas as an herbal tonic and health food and is an official drug in Indian Pharmacopoeia (1985). Ashwagandha means "the smell of horse", indicates that one who takes it would have the strength and sexual vitality of a horse. In Ayurveda it is classified as a 'rasayana' or a group of plant derived drugs that promotes physical and mental health, boosts resistance of the body against disease and adverse environmental factors, revitalizes the body in debilitated conditions and increases longevity (Gupta et al. 2003).

### Composition

The chemical composition and pharmacological and therapeutic efficacy of Ashwagandha have been well established (Buddhiraja and Sudhir 1987; Ziauddin et al. 1996). The vast ranges of applications are attributed to its chemical composition (Asthana and Raina 1998). The roots, which are used for several benefits, contain a number of steroidal lactones termed as Withanolides. The total steroid content is 2.8 % and the starch is of large size (5.6- 7m), (Grandhi et al. 1994).

### Therapeutic effects of Ashwagandha

Ashwagandha is a common 'rasayana' consumed by people of all age groups and both sexes (Sharma and Dandiya 1991) and even in pregnancy without any toxic effects (Kuppurajan et al. 1980; Sharma et al. 1985). Various investigators have reported anti serotogenic (Malhotra et al. 1955), adaptogenic, anabolic, antiarthritic (Asthana and Raina 1998; Brekhman and Dardimov 1969; Duke, 1987; Sharma et al. 1985), anticancer, anti stress (Bhattacharya et al. 1987; Grandhi et al. 1994), amebicide, diuretic, emmenagogue, growth promoting property in children (Venkatraghavan 1980), anti tumour activity (Kupchan et al. 1965; Lavie et al. 1965), anti-inflammatory (Sethi 1968) and immuno modulatory activity (Sarafand Patwardhan 1988; Saraf et al. 1989; Agarwal et al. 1999).

### Ergogenic potential and mechanism of action

The adaptogenic, antistress, antiserotogenic, anabolic and antioxidant activity and its specific characteristic to 'balance life forces' makes Ashwagandha a potential herbal ergogenic aid that can enhance the human performance. A double-blind study of supplementation of milk fortified with ashwagandha, in children of age 8-10 years showed a remarkable increase in hemoglobin, total body proteins levels and body weight (Seshadri and Sudarshan 1986). Ashwagandha has an anti serotogenic activity, stimulates the appetite and enhances food intake (Malhotra 1955). It acts as a growth promoter and increases body weight in children (Venkatraghavan 1980). The Ashwagandha extract is used as anti fatigue and anti stress agent. Khandeparkar and Kulkarni (1981) demonstrated that it could influence substrate metabolism during prolonged exercise presumably by shifting muscle metabolism in favour of lipid oxidation thus inhibiting utilization of muscle glycogen. Singh et al. 1978 explored the adaptogenic properties of ashwagandha in a series of studies. Mice subjected to physical stress by swimming, on treatment with ashwagandha exhibited a better performance and the duration of swimming increased significantly ( $P < 0.001$ ). The adaptability was seen even after 5 hours of swimming. The incidence of gastric ulcers produced by high doses of aspirin and physical stress were reduced in the mice. This indicates that Ashwagandha enhances the adaptability to physical and chemical stress.

The aqueous suspensions of roots of Ashwagandha and Korean Ginseng were tested comparatively for 2 pharmacological activities, namely anti-stress activity by the mice swimming endurance test and anabolic activity by noting gain in body weights in rats. The swimming time increased significantly in mice on incorporating Ginseng ( $P < 0.001$ ) and Ashwagandha ( $P < 0.05$ ) as compared to control group. Increase in body

Table 2. Therapeutic Effects of Herbal Supplements

Herb	Therapeutic effects	References
Ashwagandha ( <i>Withania Somnifera</i> )	Adaptogenic, anabolic, antiarthritic Anti-inflammatory  Antiserotogenic Anti cancer, Anti tumor  Diuretic Growth promoter in children Immunomodulatory	Brekhaman and Dardymov 1969; Sharma et al. 1985; Duke 1987; Asthana and Raina 1988; Sethi 1975; Malhotra 1955; Kupchan 1965; Bhattacharya et al. 1987; Sethi 1975 Venkatraghavan 1980; Agarwal et al. 1999; Saraf and Patwardhan 1988; Saraf et al. 1989.
Ginseng ( <i>Panax ginseng</i> )	Adaptogenic Antitumour Cardio protective Hypoglycemic Hypotensive Immune enhancer	Tyler 1994; Keum et al. 2000; Maffei et al. 1990; Sontanien et al. 1995; Murray 1995; Scaglione 1990.
Ginkgo <i>Biloba</i>	Anti dementia Cognitive drug, memory enhancer  Platelet activating factor(PAF) antagonist, increases fluidity and enhances peripheral circulation Neuroprotective improves cerebral insufficiency Estrogenic potential- Hormone replacement therapy	Kleijnen and Knipchild 1992; Nathan 2000; Rigney et al. 1999;  Blumenthal 1988; Tyler 1994;  Shah et al. 2003;  Oh and Chung 2004.
Turmeric (Curcumin) <i>Curcuma longa</i>	Antiatherogenic, inhibits platelet aggregation  Antitumor, anti- carcinogenic, Antimutagenic  Antispasmodic, hepatoprotective Anti-inflammatory  Antidiabeti (Hypoglycemic agent) Wound healing	Babu and Shrinivasan 1997; Mesa 2003;  Krishnaswamy and Raghuramulu 1998; Krishnaswamy 2003;  Ammon and Wahl 1991; Das and Das 2002; Krishnaswamy 2003; Babu and Shrinivasan 1997; Arun and Nalini, 2002; Jayprakash et al. 2002.



weight in Ashwagandha treated group was more than that in the Ginseng treated group. The anabolic activity may be due to the presence of steroids. Increased endurance and improved swim time has been attributed to starch (Grandhi et al., 1994). Dhuley (2000) also reported a positive increment in swim time and physical working capacity in animals.

Ashwagandha also showed relief in patients with anxiety neurosis. The drug reduces the level of plasma cortisol and urinary catecholamines (Singh et al. 1978). The root extracts of Ashwagandha (50, 100, 200mg/kg oral doses) improved retention of a passive avoidance task in a step down paradigm in mice. It also reversed the scopolamine (0.3 mg/Kg) induced disruption of acquisition and retention and reduced the amnesia produced by electro convulsive shock action (ECS) immediately after training. Daily administration of ashwagandha for 6 days significantly improved memory consolidation in mice receiving chronic ECS treatment. On the basis of these findings, it is suggested that ashwagandha exhibits nootropic-like effect in naïve and amnesic mice (Duke 1987).

An oral administration of bioactive glycowithanolides (WSG) isolated from roots, at a dose of 20 and 50mg/Kg daily once for 5 days showed the antidepressant potential of Ashwagandha. It compared well with 'imipramine', a common anti-depression drug. Forced swim- induced 'behavioral despair' and 'learned helplessness tests' confirmed the effect. The rat brain levels of tribulin, an endocoid marker of clinical anxiety reduced significantly. WSG thus acts as a mood stabilizer in clinical conditions of anxiety and depression (Bhattacharya et al. 2000). Withanolide free aqueous extract from roots exhibited anti stress activity against a battery of tests such as hypoxia time, anti fatigue effect, swimming performance time, swimming induced gastric ulceration, immobilization induced gastric ulceration, auto analgesia and biochemical changes in adrenal glands (Singh et al. 2001). Withanolides have anti-inflammatory effects. The steroidal lactones regulate modular protein synthesis. Further investigations need to be made to study the regulation of protein synthesis (Anabgan and Sadique 1981).

#### **Antioxidant effects of Ashwagandha**

The free radical scavenging activity of Ashwagandha has been studied. Administration of root powder (0.7 and 1.4 g/kg body weight/day) for 30 days produced a significant decrease in lipid peroxidation and increase in both superoxide dismutase (SOD) and catalase (CAT) (Panda and Kar 1997). The root extracts significantly reduced hepatic lipid peroxidation and also stimulated thyroidal activity in animals (Panda and Kar 1998).

The effects of Ashwagandha on copper induced lipid peroxidation and antioxidant enzymes in the spinal cord of aging Wister rats were investigated. The activity of glutathione peroxidase (GSSH) decreased significantly in the spinal cord from adult to aged mice. Treatment with Ashwagandha successfully attenuated GSSH activity and inhibited lipid peroxidation in a dose dependent manner. It inhibited both lipid peroxidation and protein oxidative modification induced by copper. These effects were similar to the effects of superoxide dismutase and mannitol (Gupta et al. 2003).

### **Side effects and toxicity**

No toxic effects have been reported in the case of Ashwagandha. A preliminary acute toxicity study in mice showed a good margin of safety (Singh et al. 2001).

### **Ginseng (Panax Ginseng)**

Ginseng is a yellowish, radish like herb. The roots are used for their therapeutic effects. It has a rich history in Eastern medicine in China, and has been used for the past 4000 years. Numerous varieties of ginseng viz. Korean, Siberian, Chinese, Asian and American ginseng have been used and widely studied. The most common is Panax Ginseng. Panax means healing. Ginseng is a tonic to increase vitality.

### **Composition**

Ginseng species differ in their composition and mechanism of action. Panax ginseng is the most complex, with 13 identified ginsenosides, which are steroid like compounds known as saponin glycosides. The root is used in herbal preparations. The interaction of ginsenosides is evidenced by the actions of ginsenosides Rb1 and Rg1, which exert different yet harmonizing influences on the body (Murray 1995).

### **Therapeutic effects of Ginseng**

Ginseng may be beneficial for NIDDM patients. Dosage of 200mg/day showed reduced fasting blood glucose levels and improvement in glycated hemoglobin (Sontaniemi et al. 1995). The ginsenosides Rb1 has a hypoactive effect on blood pressure and a mild sedative effect, whereas Rg1 exerts a mildly stimulatory action on central nervous system (Murray 1995). It stimulates immune system by enhancing natural killer cell activity, interferon production, and macrophage activity (Scalglione 1990). It prevents myocardial ischemia by being a potent antioxidant (Maffei Facino et al. 1999). It possesses anti tumour promoting activities (Keum et al. 2000).

### **Ergogenic potential and mechanism of action**

Ginseng is the most widely studied ergogenic supplement. It is widely promoted as general tonic, alone or in combination with minerals and vitamins. It increases non specific resistance and is a potent aphrodisiac (Restores or increases sexual power and desire). (International Symposium on Ginseng, 1980). The ergogenic benefit is attributed to the glycosylated steroidal saponins (ginsenosides) as active agents (Bahrke and Morgan 1994). The benefit of ginseng is to increase resistance to catabolic effects of exercise, with a secondary consequence of prolonged time to exhaustion during severe exercise. It has glycogen sparing effect and promotes fatty acid mobilization. Ginseng activates the hypothalamic- pituitary adrenal axis, brings about an increased cortisol response to strenuous exercise, enhances muscle glycogen synthesis after exercise, and enhances ability to sustain muscle creatine phosphate levels during strenuous exercise, leading to decreased lactic acid production (Williams 1989). These beneficial effects are attributed to its chemical constituents. Ginseng has anabolic properties. The gain in weight of levator ani muscle is an indicator of anabolic activity (Grandhi et al. 1994). Ginsenosides have



adaptogenic effect and studies in animals have shown that, isolated ginsenosides can stimulate as well as depress the nervous system and improve immune resistance (Brekman and Dardimov 1969; Popov 1973; Duke 1987; Bahrke and Morgan 1994; Hobbs 1996). Ginseng stimulates DNA, RNA and thereby protein synthesis in tissues, increases the production of corticotropin and cortisol in humans as well as animals (Yomamoto 1977; Fulder 1981; Odani et al. 1986). It has been found to improve endurance, maximal oxygen uptake, post exercise recovery and simple reaction time (Mc Naughton et al., 1989). Ginseng is effective for developing resistance to low temperature and stimulates faster recovery from hypothermia in cold hypoxic conditions in rats (Kumar et al. 1996). The performance enhancement from ginseng is not universally positive and highly variable. The effects are dose and duration dependent. Ginseng may enhance physical and mental performance if taken for a long time in sufficient dose. It may exert greater benefits for untrained or older subjects. Well-trained athletes may not notice benefits beyond a placebo effect except possibly during increased physical stress (Bucci 2000). Ginseng also possesses an antioxidant activity and enhances liver glutathione content in vitro and in animals (Lim et al. 1997).

**Table 3. Mechanism of Action of Herbal Antioxidants**

Herb	Ashwagandha	Ginseng	Ginkgo biloba	Turmeric
Active constituents	Withanolides	Ginsenosides	GBE extracts - bioflavonoids, quercetin, kaempferol, and isorhamnetin	Curcumin
Mode of action	<p>↓ lipid peroxidation</p> <p>Chelates Cu</p> <p>↑ SOD, CAT, GSSH</p>	<p>↓ hepatic lipid peroxidation</p> <p>Chelates metal ions</p> <p>Promotes synthesis of NO</p> <p>Inhibits free radical hemolysis of RBC</p>	<p>Prevents auto oxidation of linoleic acids, LDL, cholesterol</p> <p>Chelates Cu</p> <p>↑ SOD</p> <p>Scavenges ROS</p>	<p>↓ lipid peroxidation</p> <p>Chelates lead</p> <p>↑ SOD, CAT, GSSH Scavenges singlet O<sub>2</sub></p> <p>Protects DNA</p>

#### **Antioxidant effects of Ginseng**

The antioxidant and pro-oxidative effects of ginseng are attributed to Ginsenosides. The glucose attached to the 6- ginsenoside makes it an antioxidant (Liu et al. 2003). Ginsenoside increases body's resistance to many harmful factors and protect

tissues from damage in stress. The ginsenosides inhibit lipid peroxidation in rat liver and brain microsomes; scavenge superoxide radicals at a dose of 50 and 25mg/kg/day. They also inhibit the MDA formation in liver and enhance activity of CAT and GSSH (Deng and Zhang 1991; Zhang et al. 1996). Administration of ginseng increases the hepatic GSSH activity and reduced GSH levels in the liver with a dose- dependent reduction of the TBARS. After exercise there is reduced hepatic lipid peroxidation (Maffie 1999). The antioxidant effect of ginseng protects the organs, promotes synthesis of nitric oxide in endothelium of lung, heart, kidney and corpus cavernosum and thus helps to enhance immune resistance (Gillis 1997). Ginsenosides inhibit free radical induced hemolysis of human erythrocytes (Liu et al. 2003). Ginseng exhibits effective antioxidant activity in both lipid and aqueous media by chelation of metal ions and scavenges free radicals (Kitts et al. 2000). The methanol extract of heat-processed ginseng has potent antioxidant properties and attenuated lipid peroxidation in rat brain homogenates induced by ferric ion or ferric ion plus ascorbic acid (Keum et al. 2000).

### Side effects and toxicity

The safety of Ginseng is well documented by toxicology studies and thousands of years of use by millions of elderly people or infirm (Bahrke and Morgan 1994; Hobbs 1996). Recent reports have identified possible adverse effects. Excessive consumption of ginseng can result in 'Ginseng abuse Syndrome'. It is characterized by symptoms of insomnia, nervousness, hypertension, skin eruptions, morning diarrhea, and euphoria (Bahrke and Morgan 1994). Ginseng when adulterated with ephedrine and pseudoephedrine could account for unexplained side effects (Bahrke and Morgan 1994; Carr 1986; Chuang 1995; Hobbs 1996). Ephedrine and pseudoephedrine are banned substances.

### Ginkgo biloba

Ginkgo is the oldest living species of trees and can be traced back more than 200 million years to the fossils of the Permian period. It was used in China for hundreds of years. Ginkgo biloba extract (GBE) is the standardized preparations of Ginkgo.

### Composition

Ginkgo leaves are used in the form of concentrated standardized GBE (Ginkgo biloba extract) or EGb 761. The extract is derived from green picked ginkgo leaves that have been developed specifically for pharmaceutical purposes. The extract contains 24% ginkgo flavone glycosides (including bioflavonoids, such as quercetin, kaempferol, and isorhamnetin) and 6% terpene lactones (ginkgolides and bilobalide, compounds unique to ginkgo) (Blumenthal 1998).

### Therapeutic effects of ginkgo biloba

Ginkgo has a wide range of physiologic actions, including vasodilation, inhibition of platelet aggregation, increased oxygen and glucose utilization, and action to improve peripheral circulation (Blumenthal 1998). It is used particularly in the treatment of cardiovascular disease, and intermittent claudication (Tyler 1994). GBE is useful for



treating age related decline in mental function i.e. short-term memory loss, poor concentration, and dementia (Kleijnen and Knipschild 1992). It also improves cerebrovascular insufficiency in early stages of Alzheimer's disease. The effect is dose dependent (Brown 1995; Le Bars and Kasteloan 2000).

The flavone glycosides inhibit platelet aggregation. The ginkgolides act as platelet activating factor (PAF) antagonists. PAF promotes aggregation of blood platelets and is involved in many of the effects of allergic response. The ginkgolides apparently block these actions and, in addition, increase blood fluidity to enhance circulation (Tyler 1994). GBE is used as a cognitive enhancing drug (Nathan 2000; Rigney et al. 1999). The cognitive enhancing effects are attributed to its PAF and free radical scavenging activity and modulation of cholinergic function (Nathan, 2000). Animal studies have shown that the *anti cholinesterase* and *antidementic* properties of GBE are useful in the treatment of dementia (Dhingra et al. 2003). Treatment with GBE in animals, restored stress induced elevation of catecholamines and plasma corticosterone levels near to normal levels. The effect is attributed to the antioxidant, neuroprotective properties and improvement in cerebral insufficiency (Shah et al. 2003). GBE was found to be hepatoprotective. This ability is attributed to prevention of lipid peroxidation and replenishing the glutathione levels (Shenoy et al. 2002). In vitro study indicates that GBE and its components possess weak estrogenic activity. The potential estrogenic activity is attributed to its components quercetin, kaemferol and isorhamnetin. The extracts could thus be used in hormone replacement therapy (HRT) for postmenopausal women (Oh and Chung 2004).

### Antioxidant effects of Ginkgo biloba

The mechanism of Ginkgo biloba as a potent antioxidant is complex due to the presence of multiple active constituents. The flavone glycosides exert antioxidant activity and protect cells against free radical damage, particularly damage to the lipid layer of the cell membrane (Blumenthal 1998). The GBE has a hydrogen donating ability, reducing power, copper-binding property, free radical scavenging activity in  $H_2O_2$  / OH $^-$  in luminal system and prevents the autoxidation of linoleic acids (Lugasi et al. 1999). Aglycons, quercetin and kaemferol possess optimum antioxidant properties (Hibatallah et al. 1995). In vitro studies have shown that GBE scavenges reactive oxygen species (ROS) i.e. nitric oxide, superoxides and hydroxyl & oxyferryl radicals (Maitra et al. 1995).

Exposure to irradiation increases the formation of ROS and causes irreversible damage to cellular components. GBE on UV irradiated skin showed significant ( $p < 0.005$ ) increase in SOD activity (Aricioglu et al. 2001). Stress increases the level of MDA in cerebral cortex, diencephalons, thymus and results in ulceration of gastric mucosa. Administration of GBE prevented post stress growth of MDA in rats (Butnaru et al. 1997). Rats subjected to hypoxia for 21 days along with doses of 25 and 50mg/Kg of GBE showed lowered free radical production as compared to the control group. The antioxidant effect was not seen in the red blood cells (Louajiri et al. 2001). The effects of GBE on human erythrocyte membranes subjected to lipid peroxidation at concentrations of 0, 25, 50, 125, 250 and 500  $\mu$ g /ml suggest that the antioxidant potential GBE in erythrocyte membranes was dose dependent. It varied with composition (Kose and Dogan 1995). GBE is found to have powerful antioxidant effects against copper mediated LDL oxidative

modification (Yan et al. 1995). GBE protects against cardiac ischemia-reperfusion injury. Haramaki et al. (1994) suggested that the protective effects of GBE depend on its antioxidant properties.

The antioxidant potential of GBE was compared with the effects of water and fat-soluble vitamins. GBE was found to be more effective than water-soluble antioxidants, and as effective as lipid-soluble antioxidants. Among the lipid-soluble antioxidants there was no significant difference in potency between alpha-tocopherol and retinol acetate, but uric acid was the most potent of the water-soluble antioxidants. The antioxidant potency of GBE appears to be comparable with that of the well-known antioxidants alpha-tocopherol and retinol acetate (Kose and Dogan 1995). The extensive antioxidant effect of GBE may be valuable in the prevention and treatment of various disorders related to free radical-induced pathology.

### Side effects and toxicity

The side effects reported with the use of GBE include mild gastrointestinal complaints, headache, and allergic skin reactions, but these reactions are rare (Kleijnen and Knipschild 1992). Persons who are taking anticoagulants should use GBE with caution as GBE has a blood thinning effect (Rowin and Lewis 1996).

### Turmeric (*Curcuma longa*)

Turmeric is also called 'Haridra'. *Curcuma longa*, a perennial herb, is a member of the Zingiberaceae family. The rhizome is the portion of the plant used medicinally. Turmeric is extensively used in foods for both its flavour and colour. It has been used in the Ayurvedic and Chinese systems of medicine. The rhizome is rich in yellow orange curcuminoids and tumerins. Turmeric is widely used in Indian cooking for its flavour, colour and palatability and is known for its medicinal value. It is also used to treat cuts, bruises, and sprains and skin care and internally as antibiotic, liver protectant and digestive aid. Its actions are anti-inflammatory, antioxidant, antiseptic, anticancer, antihepatotoxic, anticholesteremic, cell regenerating and antibacterial. It is an adaptogens well as bioprotectant (Beotra 2002).

### Composition

Curcuminoids, curcumin (diferuloyl methane) and its structurally related compounds comprise the phenolic yellowish pigment of turmeric. It has been reported that 2.71–5.18 g/100 g curcuminoids is present in commercially available turmeric powders (2) and that 0.34–0.47 g/100 g is present in curry powders (Hiserodt et al. 1996).

### Therapeutic effects of turmeric

Turmeric extracts have antiatherogenic effect. Feeding turmeric in animals has shown reduction cholesterol levels (Soudamini et al. 1992; Krishnaswamy 2003; Mesa et al. 2003). The effect is attributed to the reduction in susceptibility to oxidation of cellular and subcellular membranes of erythrocytes and like microsomes the potential cause of atherosclerosis. Curcumin when fed to diabetic animals showed higher levels of hepatic



cholesterol-7 hydroxylase activity suggesting a promotion of cholesterol catabolism (Babu and Shrinivasan 1997). Turmeric and curcumin increase detoxifying enzymes in the liver and intestinal mucosa and prevent DNA damage, improve DNA repair, decrease mutations and tumor formations in the appropriate animal species. Clinical human trials have shown that small doses of turmeric such as 1 g/day can have significant impact on excretion of mutagens in urine and can also reverse palatal lesions in smokers who have increased risk for palatal cancers (Krishnaswamy 2003). Turmeric has a good potential for wound healing. Curcumin possesses powerful inhibition against  $H_2O_2$  damage in human keratinocytes and fibroblasts (Jayaprakasha et al. 2002). In vitro, curcumin exhibited antispasmodic activity. Turmeric extracts have a protective effect on the liver and a stimulation of bile secretion in animals; Curcuma longa has been advocated for use in liver disorders. Evidence for an effect on liver disease in humans is not yet available (Ammon and Wahl, 1991).

Thus turmeric exhibits antimutagenic, anti-inflammatory, antitumour and antioxidant properties (Ammon and Wahl 1991; Krishnaswamy 1998; Jayaprakasha et al. 2002; Iqbal et al. 2003).

### Antioxidant effects of Curcumin

Curcumin has been shown to have significant antioxidant activity both in vitro and in vivo (Kunchandy and Narasinga Rao 1990; Sharma 1976). Diabetics show increased levels of circulating ROS. It is due to increased lipid peroxidation and decreased antioxidant status. Curcumin is found to abolish ROS generation (Balasubramaniam et al. 2003). Administration of turmeric or curcumin to diabetic rats reduced the blood sugar and glycosylated hemoglobin levels. This was demonstrated by the lower levels of TBARS which may due to the decreased influx of glucose into the polyol pathway leading to an increased NADPH/ NADP ratio and elevated activity of the potent antioxidant enzyme (GSSH) (Arun and Nalini 2002).

Curcumin protects against lipid peroxidation induced by toxic metals lead and cadmium (Daniel et al. 2004). Curcumin has a protective effect against lead induced neurotoxicity in rats. Exposure to lead increases lipid peroxidation (LPO) and decreases GSSH. Supplementation of curcumin to lead exposed rats showed a significant reduction in LPO and a significant increase in reduced GSH, SOD and CAT activities in all four regions of rat brain (Shukla et al. 2003). Effect of oral administration of curcumin on lipid peroxidation in various organs of mice viz. liver, lung, kidney and brain was studied in a double blind study. The animals were given carbon tetrachloride, paraquat and cyclophosphamide. Administration of curcumin significantly reduced lipid peroxidation and cholesterol levels (Soudamini et al. 1992).

Curcumin has significant abilities to protect DNA from singlet oxygen. The protective ability of was found to be higher than that of well-known biological antioxidants lipoate, alpha tocopherol and B carotene (Subramanian et al. 1994). EPR spectroscopic techniques have demonstrated that curcumin is only able to effectively quench singlet  $O_2$  at a very low concentration in aqueous systems (Das and Das 2002).



## Conclusions

Physically active people consume antioxidant vitamin and minerals to battle stress and improve physical performance. These supplements are found to be effective in various ways- improve endurance, faster recovery from strenuous exercise. The other important beneficial effect seen in elite athletes is improvement in immune systems, reduces infections, injury, enhances recovery which enables them to train longer (Karlsson 1997). A large number of studies have reported the potential benefits of these supplements both short term as well as long term. Despite the relatively large number of studies performed to date on a number of antioxidant nutrients, the lack of uniformity in design has made it difficult to fathom their efficacy.

Herbs differ from synthetic supplements in their mechanism of action as antioxidants. The difference is attributed to their complex constituents and structures. Herbs are adaptogens; combat not only physical as well as mental stress. The effect of herbs is related to the stimulus. The mode of action is associated with the stress system. Ashwagandha and Ginseng have anabolic properties and can boost the human performance by reducing lipid peroxidation and effective use of substrates. The chemical constituents in herbs have the ability to chelate metal ions. Herbs enhance activity of antioxidant enzymes and also help to improve immune resistance due to synthesis of NO. The ability to overcome oxidative stress by herbal supplements is well comparable with well-known biological antioxidants.

The present review explored the therapeutic, ergogenic and antioxidant effects of selected herbal supplements. Ginseng and Ginkgo biloba have been studied and widely used. Comparative studies of Ashwagandha and Ginseng have shown Ashwagandha to be more effective. Turmeric is also studied for its therapeutic benefits but antioxidant and effects on exercise need to be explored.

The herbal supplements although available in plenty need to be thoroughly investigated for their source, purity, chemical constituents, pharmacological properties, hormonal effects, mechanism of action at molecular level. The documented effects of herbs as antioxidants are mostly studied in animals and hence there is a need to study the same in humans as well.

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## A COMPARATIVE STUDY ON THE NUTRITIONAL QUALITY AND ACCEPTABILITY OF ORGANIC AND CONVENTIONAL RAW RICE

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Organic agriculture is a production system which aids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additives. Conventional farming is the green revolution chemical farming. Green revolution, which has diminished and destroyed our indigenous knowledge of agriculture. The nutritional quality of food grown by organic and conventional method is the subject of great controversy. The present study compares the selected nutrients like carbohydrate, protein, sodium, potassium and brix value in selected organic and conventional cereals and pulses. The organic and conventional samples selected for the study are raw rice, whole wheat flour, bengal gram dal, whole green gram and black gram dal. The results of the study showed that the potassium content was three and half times higher in organic raw rice compared to conventional raw rice. The sodium, potassium and brix value content of organic whole wheat flour was high compared to conventional ones. Organic bengal gram dhal had high protein, potassium and brix value compared to conventional ones. But organic whole green gram had high potassium and brix value than conventional whole green gram, whereas organic black gram dhal had high potassium value than conventional black gram dhal. The presence of spikes in organic raw rice indicates the superior nutritional quality as compared to conventional raw rice in circular paper chromatography. Visual analysis of organic and conventional raw rice in capillary dynamolysis showed that the bands were intensive in organic as compared to conventional raw rice. The visual analysis of organic raw rice has better quality as compared to conventional raw rice by sensitive crystallization. The acceptability of organically grown raw rice was found to be significantly better than conventionally grown raw rice in terms of taste and percentage acceptability. Thus it is concluded that the nutritional quality and acceptability of organic raw rice is better compared to conventional raw rice.

The fundamental basis of many ecological farming systems is "Healthy soil equals healthy food resulting in healthy people". Even though India is one of the largest producers of cereals and pulses, there has been a massive destruction of their own cultivated crops, and the present scenario emphasizes the fall out of industrialized agriculture due to loss of bio-diversity. Organic agriculture is a production system which aids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additives (Thampan 1995). The farmers of India and China are known as "farmers of forty centuries", and it is organic farming that sustained those.

The nutritional quality of food grown by organic and conventional method is the subject of great controversy. This was one of the reasons for the study to be taken up by the investigator. The prolonged use of chemicals on soil has resulted in human health



hazards and pollution of air, water, soil and food. Further the damage to soil structure, natural environment and traditional landscape has forced us to adopt our eco friendly traditional farming systems. Further, the development of resistance among pests, pathogens and weeds to chemicals is becoming a menace. Hence there is a vital need for revolution through organic farming to ensure food security and food safety. Organic food generally refers to produce that is free of chemical pesticides and herbicides, and is cultivated by eco farming methods. Foods grown through chemical inputs and mechanical farming are called conventional foods. Food quality is defined in terms of sensual, authentic, functional, nutritional, biological and ethical. The acceptability of a cooked food is assessed in terms of overall qualities like colour, appearance, texture, flavors and taste of that food. No study has been conducted in relation to sensory quality of products prepared using organically grown rice. An alternative approach of measuring food quality is the use of novel methods of qualitative analysis. These include: Image-forming techniques such as certain types of copper-chloride crystallization, rising picture chromatography and circular paper chromatography.

The main aim of the study was compare the nutrient content, the qualitative difference by holistic analytical techniques and the organoleptic acceptability in different rice preparations in organic and conventional raw rice.

### Materials and methods

The food groups selected for the study are organic and conventional cereals and pulses. Purposive sampling technique was adopted to select the food samples. The organic and conventional cereal and pulses selected for the study are raw rice, whole wheat flour, Bengal gram dhal, whole green gram and black gram dhal. The organic food samples were collected from Naturagros, 14/1A, Vasantha press road, Arunachalapuram, Adyar and conventional samples were collected from the local market. The nutrient analysis of selected organic and conventional cereals and pulses was carried out in Shri A M M. Murugappa Chettair Research Centre (MCRC), Tharamani, Chennai using standard procedures used for food samples. The analysis was carried out by the investigator in the laboratory attached to MCRC. The selected nutrients like carbohydrate, protein, sodium and potassium was estimated in both organic and conventional cereals and pulses. The brix value was also read. The total available carbohydrate content of organic and conventional food samples was analysed by Manual Clegg Anthrone method. The protein content of organic and conventional samples was estimated by Lowry's method. The sodium and potassium content was estimated by "Flame photometric method". The brix value was measured using a refractometer. The holistic analysis of organic and conventional cereals and pulses were analyzed by the investigator at MCRC laboratory, Tharamani, Chennai, in order to visualize the nutritional quality by the following methods given by Pfeiffer. Under holistic analysis or visualizing techniques, Circular paper chromatography and Steigbild and sensitive crystallization are the methods used. The acceptability of organic and conventional cereals, pulses and cereal and pulse combination was assessed using standardized recipes.

Studies reviewed and nutrients measured in each study

Author	Year	Organic	Nutrients(high)	Nutrients(low)
Asami et al.	2003	Crops	Vitamin C, iron, magnesium, phosphorus	Nitrates
Novatny	2003	crops	Minerals	Heavy metals
Carbonaro	2002	Peaches and pears	Phenolic compounds	-
Saffron	2002	Leafy vegetables and potatoes	Ascorbic acid	-
Clark	2002	Oranges	Vitamin C	-
Clayton	2002	Crops	High	Water
Soil association	2000	Foods	VitaminC, minerals, Phytonutrients	
Angela	2000	Potatoes	Phosphorus, potassium	-
Weibel et al.	2000	Apples	Flavonols	-
Spring	2000	Fruits and vegetables	Minerals	-
Woese et al.	1997	Wheat and rye products	-	Nitrates and protein
Sankaran	1996	Foods	Quality	-
Pither and Hall	1990	Tomatoes	Lycopene	-

## Results and discussion

### Nutrient Analysis – Rice (Raw)

There was not much difference in the carbohydrate content of organic and conventional raw rice when compared to NIN value. The protein content was low in conventional raw rice as compared to organic raw rice and NIN value. The sodium content in organic and conventional raw rice was estimated to be 10 mg/100g. The potassium content of organic raw rice is three and half times higher than conventional raw rice. The brix value of organic and conventional rice was 8.2 and 8.0.



**Table 1. Comparison of nutrients in organic and conventional raw rice with NIN values**

Nutrients	Organic Rice	Conventional Rice	NIN values
Carbohydrate (g/100g)	81.4	80.5	78.2
Protein (g/100g)	6.4	2.4	6.8
Sodium (mg/100g)	10.0	10.0	-
Potassium (mg/100g)	455.4	99.0	-
Brix value	8.2	8.0	-

**Holistic Analysis of Organic and Conventional raw rice****Circular paper chromatography of organic and conventional raw rice**

The visual differentiation of organic and conventional rice showed the presence of spikes in organic raw rice as compared to no spikes seen in conventional raw rice. Hence the presence of spikes in organic raw rice indicates the superior nutritional quality as compared to conventional raw rice (Plates 6- A and B).

**Capillary dynamolysis of organic and conventional raw rice**

The visual observation of organic and conventional raw rice in capillary dynamolysis showed that the dispersed bands were intensive in organic raw rice as compared to conventional raw rice. The intensiveness of the bands corresponds to the higher reductivity, which is directly proportional to high photosynthetic active principles in plants (Plates 6- C and D).

**Sensitive Crystallization of organic and conventional raw rice**

The visual differentiation of organic and conventional raw rice showed that

**Organic rice:**

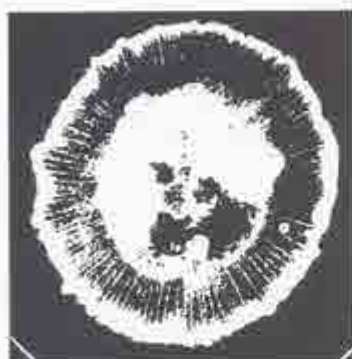
- Thick crystals are formed in the center.
- Clear crystal growth from center towards the periphery
- Two centers with six main branches of crystals
- Fine branched crystals are found in the periphery

**Conventional rice:**

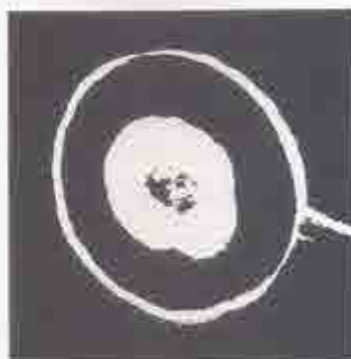
- No thick crystals are formed in the center.
- No clear crystal growth from the center towards the periphery.
- Two centers with no branches of crystals.
- Needle shaped crystals are found in the center.
- Crossing over of crystals.
- No crossing over of crystals

On comparison, Plate-6 E and F showed that organic raw rice has better quality as compared to conventional raw rice (Plates 6E and F).

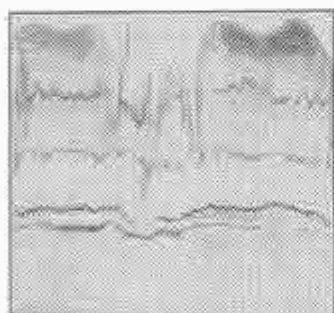
**Plate 1. Holistic Analysis of Organic and Conventional Raw Rice**



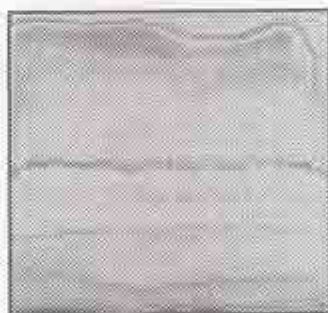
A. Organic raw rice



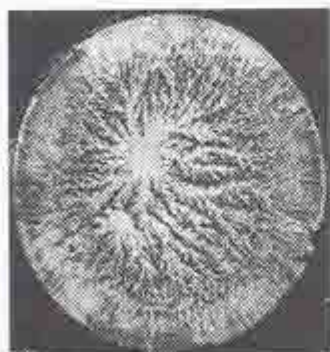
B. Conventional raw rice



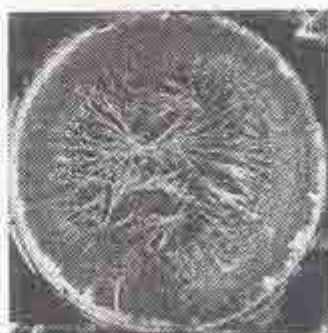
C. Capillary dynamolysis of organic raw rice



D. Capillary dynamolysis of conventional raw rice



E. Sensitive crystallization of organic raw rice



F. Sensitive crystallization of conventional raw rice

Table 2. Acceptability of selected organic and conventional rice  
(Tomato rice, coconut rice, lemon rice and curd rice)

Recipes	Qualities	Type of farming	N	Mean $\pm$ S.D.	't' value
Tomato rice	Color and appearance	Organic	10	100.0 $\pm$ 0.00	1.861 NS
		Conventional	10	96.7 $\pm$ 5.67	
	Texture	Organic	10	97.3 $\pm$ 3.44	0.372 NS
		Conventional	10	98.0 $\pm$ 4.50	
	Flavor	Organic	10	100.0 $\pm$ 0.00	1.000 NS
		Conventional	10	99.3 $\pm$ 2.12	
	Taste	Organic	10	96.7 $\pm$ 6.48	4.968 **
		Conventional	10	78.0 $\pm$ 9.96	
	Percentage acceptability	Organic	10	98.3 $\pm$ 1.92	3.982 **
		Conventional	10	94.0 $\pm$ 2.85	
	Colour and appearance	Organic	10	100.0 $\pm$ 0.00	-
		Conventional	10	100.0 $\pm$ 0.00	
Coconut Rice	Texture	Organic	10	100.0 $\pm$ 0.00	1.000 NS
		Conventional	10	99.3 $\pm$ 2.11	
	Flavour	Organic	10	100.0 $\pm$ 0.00	1.964 NS
		Conventional	10	96.0 $\pm$ 6.44	
	Taste	Organic	10	96.0 $\pm$ 4.66	3.279 **
		Conventional	10	86.7 $\pm$ 7.70	
	Percentage acceptability	Organic	10	98.8 $\pm$ 1.37	3.508 **
		Conventional	10	94.7 $\pm$ 3.50	
	Color and Appearance	Organic	10	100.0 $\pm$ 0.00	1.964 NS
		Conventional	10	98.0 $\pm$ 3.22	
	Texture	Organic	10	99.3 $\pm$ 2.11	1.567 NS
		Conventional	10	97.3 $\pm$ 3.44	
Lemon Rice	Flavor	Organic	10	100.0 $\pm$ 0.00	-
		Conventional	10	100.0 $\pm$ 0.00	
	Taste	Organic	10	98.0 $\pm$ 3.22	5.942**
		Conventional	10	84.7 $\pm$ 6.32	
	Percentage Organic	Organic	10	99.0 $\pm$ 1.61	4.172**
		Conventional	10	95.2 $\pm$ 2.42	
	Color and appearance	Organic	10	100.0 $\pm$ 0.00	-
		Conventional	10	100.0 $\pm$ 0.00	
	Texture	Organic	10	100.0 $\pm$ 0.00	1.500 NS
		Conventional	10	98.7 $\pm$ 2.81	
	Flavor	Organic	10	100.0 $\pm$ 0.00	-
		Conventional	10	100.0 $\pm$ 0.00	
	Taste	Organic	10	96.0 $\pm$ 6.44	3.183 **
		Conventional	10	84.0 $\pm$ 10.04	
	Percentage acceptability	Organic	10	98.8 $\pm$ 1.58	3.085 **
		Conventional	10	95.8 $\pm$ 2.64	

NS – Not Significant

\*\* Significant at one percent level



### Acceptability of organic and conventional cereal - raw rice (Tomato rice, coconut rice, lemon rice and curd rice)

Acceptability of the cooked product prepared from organic raw rice was found to be significantly better than the product cooked with conventional raw rice. There is a significant difference at one percent level in the taste and percentage acceptability of the cooked product (tomato rice, coconut rice, lemon rice and curd rice) prepared from organic cereal when compared to conventional raw rice. But there is no significant difference in the color and appearance, texture and flavor of the cooked product prepared from organic raw rice when compared to conventional raw rice. Thus it is concluded that recipes prepared with organically grown raw rice are significantly better than those prepared with conventionally grown raw rice.

### Conclusion

The potassium content of organic raw rice is three and half times higher than conventional raw rice. But there is not much difference in other nutrients when compare to the NIN values. The presence of spikes in organic raw rice indicates the superior nutritional quality as compared to conventional raw rice in circular paper chromatography. The visual analysis of organic raw rice has better quality as compared to conventional raw rice by sensitive crystallization. The acceptability of organically grown raw rice was found to be significantly better than conventionally grown raw rice in terms of taste and percentage acceptability.

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## EFFECT OF INCORPORATION OF WHEY PROTEIN CONCENTRATE ON SENSORY AND STORAGE CHARACTERISTICS OF SELECTED RAGI AND WHEAT BASED PRODUCTS

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Utilization of whey protein solids in food formulation is of great significance in view of their excellent functional nutritional properties. This investigation was undertaken to explore the possibility of whey protein concentrate utilization to enhance the nutritional profile of ragi and wheat based foods. WPC, which had 40 percent protein, was utilized for substitution of ragi and wheat flour at different percentages for preparation of food products. From the shelf life study of the products it was observed that the ready to prepare product mixes possessing WPC were accepted even after three months of storage period and did not show any significant difference in the sensory qualities. The initial and final microbial count of the product mixes stored for three months revealed that the bacterial and fungal count of the products was within the acceptable limits. No coli form colonies were detected. The production cost of the mixes were 20 to 30 percent more than that of regular product mixes which can be considered affordable with respect to nutritional increase provided which could solve the nutritional problem of the vulnerable segment of the society to a greater extent changing the food habits or incurring excessive expenditure.

Whey protein concentrate (WPC) as defined by US Food and Drug Administration as the substance obtained by the removal of sufficient non-protein constituents from whey so that the finished dry products contains not less than 25 per cent protein (Renner and Abd-El-Salam, 1991). WPC represents a rich and varied mixture of protein with wide ranging chemical, physical and functional properties (Jayaprakasha and Bruekner 1999). These proteins not only play an important role in functional properties, but also contribute excellent nutritional properties being exceptionally rich and balanced source of amino acids (Regester et al. 1996). Therefore, incorporation of WPC in to cereal products increases their protein content by increasing the content of essential amino acids such as lysine. Keeping in mind the limiting amino acids in cereals, nutritional and functional properties of WPC the present study was carried out to incorporate WPC in ragi (*Eleusine coracana*) and wheat (*Triticum aestivum*) based food mixes.

### Materials and Methods

Control and WPC incorporated ragi malt, ragi dosa, wheat chapatti and wheat masala roti mixes were prepared with standardized levels of ingredients as per the method reported by Vaidehi (1994). Whey protein concentrate (WPC) was prepared by ultra filtration as per the procedure outlined by Jayaprakasha (1992) and analyzed for nutrients (fig.1). The above products were prepared at various levels of WPC blend (10-40%) as per the recipe and were evaluated for their sensory attributes by a taste panel of ten experienced judges for appearance, texture/consistency, aroma, taste and overall acceptability. The best accepted blend of WPC i.e., ragi malt mix (30% WPC), ragi dosa



mix (20% WPC), Chapati mix(10% WPC) and wheat masala roti mix(20% WPC) were selected for storage studies.

Product mixes like ragi dosa mix and wheat masala roti mix were prepared by dehydrating carrots, onions, green chilli, ginger, coriander leaves and curry leaves in hot air oven at 60°C, powdering and mixing thoroughly with the other ingredients. The ready to prepare mixes were packed and sealed in polythene pouches (200 gauge) and were maintained at room temperature for three months study. The products were prepared at 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> month and evaluated by the panel of judges for the sensory evaluation.

**Microbial analysis:** Initial and final microbial count of the above product mixes were carried out according to ISI method (1980) and cost of the mixes were calculated by taking into consideration the product cost of each product, including fuel expenses and packaging cost.

**Statistical analysis:** One way analysis of variance was applied on the sensory score at ten panel members for different quality characteristics at five per cent level of significance to find out the difference between fresh and stored test products.

## Results and Discussion

The sensory evaluation of the products did not show any significant difference in the sensory qualities even after third month of storage. Storage study of ragi malt mix with WPC showed that even after the first month of storage period, there was no change in the overall acceptability of ragi malt but surprisingly the score for overall acceptability increased on second month. On the third month again the acceptability decreased, but the extent of difference was not significant.

Ragi dosa mix scored highest for all its sensory qualities when it was fresh. On first and second month though ragi dosa mix had same score for texture, aroma, the product had a less score for appearance (4.2 each) but had a better score for taste. On third month of storage a change in appearance and aroma were observed. The mean scores for the above two sensory characteristics were 3.6 and 3.4, respectively. No change was observed in texture and had same score for taste as fresh one (3.5). Statistically no significant difference was obtained in any of the sensory attributes at 5 per cent level except for appearance (Table 1).

Table 1. Nutritive value of whey protein concentrate

Nutrients	Amounts per 100g
Moisture (g)	5.0
Protein (g)	39.8
Fat (g)	2.0
Energy (kcal)	358.0
Carbohydrate (g)	45.3
Total ash (g)	7.9
Calcium (mg)	1000.0
Phosphorous (mg)	600.0



During the three months storage period of chapatti mix, no change in the appearance, taste and overall acceptability till the end of second month and no change in texture and aroma throughout the storage period was observed. There was a change in appearance, taste and overall acceptability on third month, but none of the sensory characteristics were significantly different from others.

The storage studies of wheat masala roti mix with WPC, the sensory evaluation has shown no significant difference in any of the sensory attributes even at the end of the third month though the scores gradually decreased every month except for

Table 2. Mean Scores for Storage Studies of WPC Blended

Wheat Products

Storage Period (Months)	Appearance		Texture		Aroma		Taste		Overall Acceptability	
	RM	RD	RM	RD	RM	RD	RM	RD	RM	RD
Initial	4.1	4.3	4.0	3.6	3.7	3.7	4.1	3.5	4.1	3.9
I month	4.1	4.2	4.0	3.6	3.6	3.7	4.0	4.0	4.1	3.8
II month	4.0	4.2	3.9	3.6	3.6	3.7	4.0	3.9	4.2	3.7
III Month	4.0	3.6	3.9	3.6	3.6	3.4	3.9	3.5	3.9	3.5

n=10;

RM-Ragi Malt;

RD-Ragi Dosa

Table 3. Microbial count (c.f.u/g) of the test product Mixes on Storage

Product Mixes with WPC	Fungal Count			Bacterial Count		
	Initial	Final (3Months (%))	Growth	Initial	Final (3Months (%))	Growth
Ragi Malt	$10 \times 10^2$	$15 \times 10^2$	50	$38 \times 10^2$	$44 \times 10^2$	16
Ragi Dosa	$8 \times 10^2$	$0 \times 10^2$	25	$35 \times 10^2$	$42 \times 10^2$	10
Chapati	-	-	-	$5 \times 10^2$	$6 \times 10^2$	20
Wheat Masala Roti	$15 \times 10^2$	$20 \times 10^2$	33	$41 \times 10^2$	$46 \times 10^2$	12

Note:

Cf.u/g = colony forming units per gram of sample.

Standard acceptable limits of Microbial count in flours:

- Fungal Count =  $5 \times 10^4$  c.f.u/g (IS:1969).
- Bacterial Count =  $5 \times 10^4$  c.f.u/g (ISI guidelines:1980).

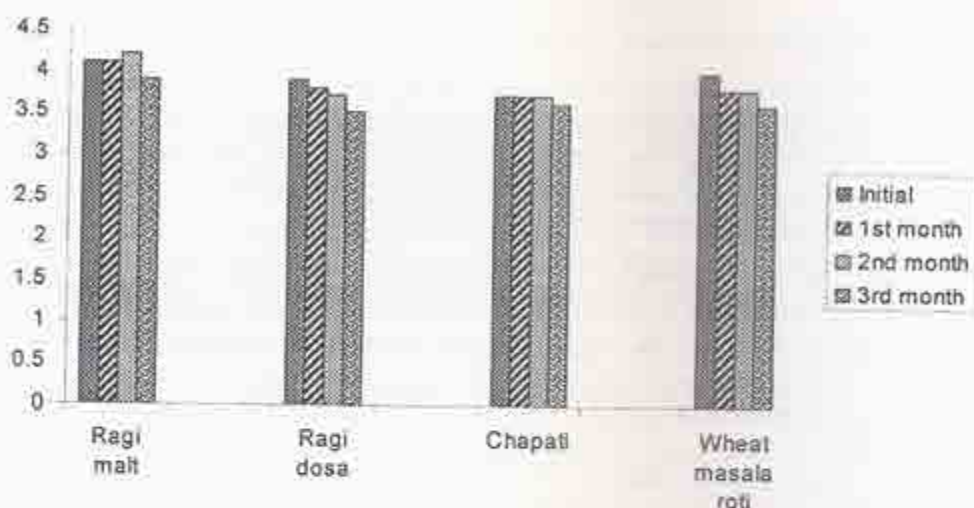


Figure 1. Mean scores for the overall acceptability of ragi & wheat based Products

Table 4. Productions Cost of WPC Blended Ready to Prepare Mixes.

Ready to prepare Mixes	Production cost/kg (Rs)		Difference in cost of production(Rs)
	Product Mixes (control)	Product Mixes (With WPC)	
Ragi Malt	22.0	26.5	4.5
Ragi Dosa	32.5	41.0	8.5
Wheat chapatti	17.5	23.0	5.5
Wheat Masala roti	22.5	26.5	4.0

The bacterial and fungal counts of ragi product mixes were below the ISI specification of  $5 \times 10^4$  c.f.u/g (Table-3). Chandrashekar et al. (1988) had suggested a feasibility of storing malted weaning food in polythene packets at household levels. Similar storage studies carried out on malted nutri-mixes by Chandrakala (1998) showed similar pattern of fungal and bacterial counts during the three months of storage. In the case of wheat products no fungal growth was found in the beginning and end of the experiment for chapatti mix. The bacteria count was below the maximum level as specified by ISI for chapatti and wheat masala roti mix. The storage studies of the above two products are in agreement with the storage study results reported by Kulp et al. (1988), who observed a long period freshness of the white bread with six per cent whey. Awasthi and Yadav (1998) reported that the overall qualities of soy-biscuit with whey, packed in laminated packaging material stored for 30 days remained unchanged.

The production cost was estimated by taking the prevailing cost of all ingredients in the market (Table 4). The cost of WPC blended product mixes were 20 to 30 per cent

more than that of regular product mixes which can be considered affordable with respect to nutritional increase provided.

WPC can be used up to the extent of 30 per cent in ragi and 20 per cent in wheat based product to enhance the quality of nutritive value. The storage stability of product mixes and nutritive value, it can be expected that WPC product mixes have better nutritional quality and great for eliminating the protein-calorie malnutrition. There is a need to popularize this byproduct of dairy industry to explore their nutritional value for public to obtain better nourishment by formulating in various cereal and millet based products of local interests.

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## MICROBIOLOGICAL QUALITY OF FOODS SERVED IN AN INDUSTRIAL CANTEEN.

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**Keywords.** : Microbiological safety, foods, food contact surfaces and industrial canteen.

Access to good quality and safe food is considered the basic right of the people. Consumption of unsafe, contaminated food leads to food borne diseases. Hence, the microbiological quality of foods served in an industrial canteen was assessed. The results revealed that curds had the highest counts for *Coliforms* ( $1.33 \times 10^6$  cfu/g) followed by the chopped leaves even had the highest SPC ( $1.56 \times 10^4$ ). All the foods analysed tested negative for the presence of *Salmonella*, *Shigella*. The water samples were free from *Coliforms*. *Coliforms* were detected in all the food contact surfaces and *E. coli* was detected only near the washing area.

Microorganisms are ubiquitous in distribution, so they can gain entry into the food chain from various sources. The food chain is linked to all stages of production processes from the supply of agricultural inputs, primary production, processing, and storage till final consumption. Thus when the food gets contaminated, they become significant vehicles of disease producing agents like pathogenic organisms or their toxins. Food borne diseases particularly from biological sources are presenting a persistent challenge to the public health worldwide. New and emerging pathogens are appearing and new food vehicles continue to be implicated as a result of changing industrial ecology of food production and consumption. (Bhat and Vasanthi 2000).

The trend of eating outside one's home is on the increase during the recent years due to the variety of reasons such as rapid urbanization, changing life style, emerging of nuclear families, increased number of working women, changing life style etc. A number of people who work outside their homes consume food in hotels, restaurants or the office canteen. Two important components associated with the food-borne diseases are catering establishments and food handlers. Thus the present study was undertaken to assess the microbiological quality of the foods served in an industrial canteen in Bangalore.

### Materials and Methods

Food samples selected for microbiological analysis were cooked rice, chicken curry, curds and raw foods (Salad, turmeric powder and chopped coriander leaves.)

Approximately 100 gm of the food material were collected aseptically with a metal spoon after it had been washed, rinsed and immersed in 95% alcohol and flamed after immersion. Samples were transferred into sterile polythene bags and sealed. The sample bags were put into an insulated plastic box containing ice. Samples were held in ice until

they reached the laboratory where they were transferred to the refrigeration maintaining the cold chain.

All the samples were homogenized for microbial analysis. Samples of cooked foods and raw foods were emulsified by suspending 11 gm of sample into 99 ml of phosphate buffer and the mixture was shaken well, serial dilutions were made. Aliquots of the appropriate dilutions were enumerated for SPC using nutrient agar, *Coliforms* using MacConkey agar (IS: 5402: 1969 AND IS: 5401: 1969). Inoculated plates were incubated at requisite time – temperature combinations using suitable growth conditions.

The food samples were also tested for the presence of *Salmonella* and *Shigella*. For detection of *Salmonella* and *Shigella*, 25 gm sample aliquots were weighed and dispensed in 25 ml of buffered peptone water which was incubated at 37°C for 20 hours for pre-enrichment. This was followed by selective enrichment of 10 ml culture in 100 ml of selenite / cystine broth at 37°C for 24 hours. For isolation of *Salmonella*, a loopful was streaked into pre-poured plates of brilliant green (BG) agar and *Salmonella*, *Shigella* (SS) agar simultaneously and incubated for 24 hours at 37°C (IS – 5887: Part 3, 1999 and Himedia Manual for microbiology practice, 1998). The suspected cultures showing typical dark coloured colonies were isolated and confirmed by biochemical tests.

Water samples were collected from various sources in the canteen like main water sump, overhead tank, kitchen tap and water purifier and were analysed for *Coliforms* (IS: 5401: 1969) and *E. coli* (IS: 5887: Part 1, 1976). Swabs were taken from various food contact surfaces like wooden chopping board, washing area, working area, food handlers' palm and tested for presence of *coliforms* and *Escherichia coli* (IS: 5887: Part 1, 1976).

A Hazard Analysis Critical Control Point (HACCP) plan was developed for the foods served in the industrial canteen. Critical Control Points were determined for the hazards identified and the corrective measures were recommended.

## Results and Discussion

Microbial analysis revealed that curds had the highest SPC ( $1.33 \times 10^6$  cfu/g) followed by coriander leaves ( $7.1 \times 10^5$  cfu/g) followed by curds ( $1.20 \times 10^5$  cfu/g) and salad ( $4.6 \times 10^4$  cfu/g) (Table 1). According to Sharma and Joshi (1992), milk and its products curds, icecream, paneer, khoa etc provide an ideal medium for the growth of microorganisms. In the present study the curds served in the canteen were purchased from the market, hence the possibility of high microbial load in curds. Rao (1995), reported SPC for curry leaves to be  $2 \times 10^5$  cfu/g and *Coliforms* count of  $4 \times 10^3$  cfu/g. In the present study the higher counts of SPC and *Coliforms* in the coriander leaves may be due to improper washing of coriander leaves, contamination from food handlers and from food contact surfaces like knife, chopping boards, utensils etc. Hence the Critical Control Points (CCP) determined for cooked foods were purchase of raw material where there were chances of chemical contamination and presence of pesticide residues, cooking and holding foods until consumption. Similarly purchase of raw material and holding foods till consumption was CCP for raw foods like salads, chutneys and curds / buttermilk. Washing, Cutting/chopping, addition of water was common CCPs for raw foods like salads,



chutney and curds / butter milk. Mashing the chopped ingredients with hands was identified as a CCP for buttermilk.

Salad consisted of cucumber, tomato and onion which were chopped and kept uncovered in closed cabinet for 45-60 minutes before serving and transferred to serving tables 10-15 minutes before lunch.

Hence keeping the salad in an uncovered condition was the CCP as it led to high microbial load (Table 1). Salads are consumed raw and thus can act as an effective media for the contamination.

Table 1. Microbial Quality of food samples.

Samples	SPC (cfu/g)	Coliforms (cfu/g)
Rice	$4 \times 10^2$	$1.5 \times 10^2$
Curds	$1.33 \times 10^6$	$1.20 \times 10^3$
Coriander leaves	$7.1 \times 10^5$	$1.56 \times 10^3$
Salad	$1.2 \times 10^5$	$4.6 \times 10^4$
Turmeric powder	$4.0 \times 10^4$	$3.8 \times 10^3$
Chicken curry	$2.5 \times 10^4$	$3.0 \times 10^1$

*Salmonella* and *Shigella* were not detected in any of the food samples in the present study. Similarly *Salmonella* was also not detected in Houmpos (chickpea dip) samples as reported by Yamani and Dababsch (1994). Kakar and Udipi (2002) detected the presence of *Salmonella* in the ready to eat meat and meat products sold on Mumbai city but reported the absence of *Shigella* in the same. Presence of *Salmonella* in the cooked non-vegetarian foods indicates poor hygiene and inadequate cooking along with situations like lapse of time between preparation and serving and inadequate reheating just before serving (Kakar and Udipi 2002).

The samples collected from various sources in the canteen namely sump, overhead tank, kitchen tap and water purifier tested negative for the presence of *Coliforms* and *E.coli*. *Coliforms* was also not detected in both tap water and stored water samples in street vending operations in a study conducted by Bajaj et al. (2002). The result of the present study indicated that water is of excellent category according to the scoring system by Vanchinathan (1992), which corroborated the use of potable water in the canteen. Swabs taken from various food contact surfaces like wooden chopping board, washing area, working area and palms of food handlers for *Coliforms* and *E. coli* showed that *Coliforms* were found to be present in all the surfaces areas from where swabs were taken (Table 2).

*E.coli* was detected only from the washing area which is an indicator of faecal contamination and the possible sources could be the use of unwashed raw materials. The *Coliform* count was also higher in the washing area ( $16 \times 10^7$  10 cm<sup>2</sup>) compared to the other surfaces. The presence of *Coliforms* in the palms of food handlers indicated improper practices of washing hands.



Table 2. Microbial load of food contact surfaces.

Swab	Coliform	E. coli
Wooden chopped board	$9 \times 10^1$ cfu / $10\text{cm}^2$	N. D. *
Washing	$16 \times 10^4$ cfu / $10\text{cm}^2$	$7 \times 10^1$ cfu / $10\text{cm}^2$
Working area	$29 \times 10^1$ cfu / g	N. D. *
Food handlers palm		
1	$16 \times 10^1$ cfu / palm	N. D. *
2	N. D. *	N. D. *
3	$2 \times 10^1$ cfu / palm	N. D. *

Note: N. D. \* - Not Detected

The results thus indicated that the foods served the canteen could be judged as having satisfactory microbial quality and the same may be improved by following strict adherences to hygiene and sanitation. A HACCP plan was developed for the canteen and implemented. Certain corrective measures were also recommended such as purchase of raw materials from approved supplies and proper washing of raw materials by two step presence of microorganisms on surface; chemical contaminants and pesticide residues, heating the food to a minimum temperature of  $100^\circ\text{C}$  / 10 minutes (boiling point) while cooking, instructing workers for conformance to dress code and serving the foods in a covered condition and storing the same for not more than two hours.

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## DEVELOPMENT OF LOW COST ENTERAL FEEDS WITH REFERENCE TO THEIR NUTRITIONAL QUALITY

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Nutrition plays a vital role in determining the ability and speed of recovery from illness / surgery. Enteral nutrition / feeding, which involves delivery of nutrients through nasal tube into the gastrointestinal tract, in case of patients having difficulty in chewing and swallowing but with functioning and accessible gastrointestinal tract, forms the preferred nutrition support. Since the average Indian patient can not afford the commercially available enteral feeds due to its cost, an attempt has been made in the present study to formulate some low cost enteral feeds employing commonly used cereals and pulses like wheat, rice, ragi, green gram dhal and soya bean and evaluate their nutritional quality. Germinated wheat, ragi, green gram and soya bean together with rice were milled into fine flour individually and different formulations were prepared. The processed Cereal-Pulse blends were further fortified with sugar and edible oil to meet the nutritional needs of patients. The blends were analyzed for nutrient and mineral composition, dietary fiber, starch fractions and digestibility and physico-chemical properties. The Protein Efficiency Ratio (PER) of selected blends ranged from 2.16 to 2.63, indicating good protein nutriture of the blends. The protein content of blends ranged from 15-20%. Blends containing wheat and soya had higher level (420%) of protein. The total dietary fiber ranged from 15.6 – 19.6% and the starch digestibility index (SDI) ranged from 20-63g/100g. Blends containing ragi had higher readily digestible starch (RDS) (21.4-30.5 g/100g), thus, a higher SDI value 58-61. The formulated foods in a free flowing form are ready to use on reconstitution with warm water. These provide nearly 400 Kcals and 16.1g proteins per 100g. The processed cereal pulse blends thus appear to be an ideal alternative to feeds available commercially. In conclusion enteral feeds may be developed, by using natural food ingredients to provide good nutritional support to a wide range of patients.

In patients, hospitalized for various ailments, malnutrition / under nutrition is a common and under recognized problem which adversely affects their speedy recovery while escalating the hospital costs due to increased hospital stay. Several studies indicate that during hospitalization a combination of the effects of impaired nutritional status, increased metabolism, increased nitrogen excretion, anorexia and prolonged periods of fasting for the purpose of investigations can rapidly lead to a negative nitrogen and energy balance which in turn can result in impaired immune function, decreased muscle / respiratory function and strength, increased sepsis, delayed wound healing and increased post operative morbidity and mortality (Whirter and Pennington 1994; Allison 1995; Chandra 1990).



Under such situations nutrition plays an important role in determining the ability and speed of recovery of the person from illness / surgery. In case of patients who are unable to meet their nutritional requirements orally due the difficulties chewing and swallowing despite their functioning and accessible gastro intestinal (GI) tract, enteral nutrition / feeding, which involves delivery of nutrients by nasal tube into the GI tract, forms the preferred route of nutrition support (Kinney 1987).

Expanding knowledge of specific disease processes have led to the development of a wide range of nutritionally complete enteral foods, formulated with more specified nutritional strategy to suit ones appetite, keeping in view the ailment in question. The selection of these foods are based on the individuals gut function, fluid requirements, period of feeding, energy and nitrogen requirements, electrolyte status and method of feeding. Generally these foods are prepared by blending chemically defined ingredients, such as sugar, malto dextrin / hydrolyzed starch (carbohydrate source) and casein, amino acids / hydrolyzed protein (protein source) fortified with essential macro / micro nutrients (Kinney 1987). A major limiting factor in the use of the commercially available enteral feeds in India is their cost, as a result of which, their use becomes limited considering the economic conditions of Indian patients. Hence these foods can only be used as supplements to the blenderized feeds in most cases.

The present preliminary study was planned with a view to explore the possibility of formulating low cost enteral feeds utilizing indigenous food sources like cereals and pulses, which constitute predominantly the diets of an average Indian, and evaluate the blends thus formulated for their nutritional and functional characteristics.

### Materials and Methods

#### Selection and Formulation of Enteral Feed:

Keeping in view their wide utility and their nutrient composition, three Cereals, viz., Rice (*Oryza sativa*), Ragi (*Eleusine Caracona*), Wheat (*Triticum aestivum*) and two Pulses, viz., Green Gram Dal (*Phaseolus aureus*) and Soya Bean (*Glycine Max*) were selected for the study. While rice is rich in digestible carbohydrates, wheat and ragi form a good source of dietary fibre with the latter being an excellent source of calcium and iron. On the other hand soy bean stands next to animal protein in its protein nutriture. Green gram is also a good source of available protein and minerals especially on germination. Several Cereal-Pulse blends which were formulated for this study include:

- |    |                          |                       |
|----|--------------------------|-----------------------|
| 1. | Ragi : Soya              | (Ra: So 3:1)          |
| 2. | Ragi : Green gram        | (Ra: Gg 3:1)          |
| 3. | Rice : Soya              | (Ri: So 3:1)          |
| 4. | Rice : Green gram        | (Ri: Gg 3:1)          |
| 5. | Wheat: Soya              | (Wh: So 4:1)          |
| 6. | Ragi : Wheat :Soya       | (Ra: Wh So 2.5:1.5:1) |
| 7. | Rice : Ragi : Soya       | (Ri : Ra So 2:1:1)    |
| 8. | Rice : Ragi : Green gram | (Ri: Ra :Gg 2:1:1)    |



All the raw materials used in the preparation were procured in bulk from the local market to eliminate batch/lot variations, if any. The cereals and pulses were cleaned by hand picking, germinated (except rice), air dried, roasted and milled individually. Defatted Soya Flour was also roasted before mixing in the above cereal pulse (CP) blends.

## II. CHEMICAL ANALYSIS

**A. Proximate Composition:** All the blends were analysed for their proximal score by the standard methods of AOAC (1986).

### **B. Carbohydrates:**

**1. Sugars:** The reducing and total sugar content was estimated titrimetrically using the Shaffer Somogyi Micro Method (AOAC 1986).

**2 Starch:** Different fractions of starch viz., Rapidly Digestible Starch (RDS), Slowly Digestible Starch (SDS) and Resistant Starch (RS) was also measured (Englyst HN et al. 1992).

**3 Dietary Fiber:** The total dietary fibre was measured by the enzymatic gravimetric method of Asp et al. (1983).

### **C. Minerals:**

Calcium, Phosphorous and Iron contents were evaluated by the standard methods described elsewhere (Hawk 1965).

### **D. Preparation of Diets:**

Standard Casein Diet A

Calculated quantity of Casein rendered vitamin-free by washing commercial casein several times with alcohol and subsequently drying, was incorporated into the basal diet (Table 1) at the expense of cornstarch to provide  $10 \pm 0.3\%$  proteins on moisture free basis. The mixture was thoroughly homogenized by sieving it a number of times. The diet thus obtained was packed and stored in food grade, airtight plastic containers. The diet was prepared once a week in quantities required for feeding 10 rats.

### **Experimental Diets: B, C and D:**

Good quality rice (Bangara tennae), ragi, green gram and defatted soy flour were procured from the local market in one lot in quantities required for the preparation of the diets B, C&D and sufficient to feed 10 animals in each group for 28 days.

Ragi and green gram were soaked over night at room temperature and kept in dark for 36 hrs for germination. Then it was dried in an air oven at 65 °C until completely dry and milled into fine flour in a stone mill. Similarly rice was also powdered into fine flour. These powders together with dried defatted soy flour were mixed / blended in various proportions as given under.

**Table 1. Composition of basal diet used in preparing control and experimental diets with 10% protein**

Ingredients	Weight used (g %)
Corn starch	85
Refined groundnut oil	9
Salt mixture USP XVIII <sup>a</sup>	4
Vitaminsed starch <sup>b</sup>	1
Shark liver oil fortified with Vitamin E acetate (10 mg g <sup>-1</sup> oil)	1

<sup>a</sup> Each kilogram contains : sodium chloride 139.3 g; potassium iodide 0.79 g; potassium dihydrogen phosphate 389.0 g; tamin B<sub>12</sub> 2.0 mg; biotin 0.02 mg; folic acid 0.2 mg; corn starch 754.36 mg.

magnesium sulphate anhydrous 57.3g; calcium carbonate 381.4 g; ferrous sulphate 27.0 g; manganese sulphate 4.01 g; zinc sulphate 0.548 g; copper sulphate 0.477 g; cobalt chloride 0.23 g.

<sup>b</sup> Each gram contains : menadione 0.5 mg; thiamin 0.5 g; riboflavin 1.0 mg; pyridoxine 0.4 mg; calcium panthothenate 4.0 mg; niacin 4.0 mg; choline 200 mg; inositol 25.0 mg; para-amino benzoic acid 10.0 mg; vi

Rice: Ragi: Green gram in the ratio of (2:1:1) (Blend II for diet B).  
 Ragi: Soya in the ratio of (3:1) (Blend II for diet C).  
 Rice: Soya in the ratio of (3:1) (Blend II for diet D).

Calculated quantities of the above various blends were differently incorporated into the basal diet at the expense of cornstarch to obtain a protein content of 10±0.3 % on moisture free basis. The fat component of the basal diet used for each of these diets was reduced accordingly taking into consideration the fat already present in the respective blends to obtain a final fat content of 10% in the diets on moisture free basis.

#### Bioassay:

The bioassay was conducted as per standard method (Sullivan and Carpetter 1993). Forty male weanling albino rats 21±1 days old and weighing between 35 and 40 grams were randomly divided into four groups of 10 each and assigned diets A, B, C and D respectively. The animals had free access to food and water. Weighed amounts of food moistened with a known quantity of warm water (10-15 ml) were fed daily in the mornings at a fixed time. Uneaten food was collected daily in aluminium cans, dried at 90±5°C and weighed. Weekly body weights were recorded. Protein Efficiency Ratio (PER, weight gain per g. protein consumed) was calculated at the end of 28 days of feeding period (ISI 1974).

## Results and Discussion

The protein content of the cereal-pulse (CP) blends was found to be high in Wheat and Soya (Wh:So-22 %) and lowest in Ragi and Greengram (Ra:Gg-12 %) (Table 2). The Crude fat content was highest in Rice and Soya (Ri:So - 12.02 %) and lowest in Rice and Green gram (Ri:Gg 1.23 %). The ash content of the different CP blends, were almost similar. The percent Calcium content was highest in Ragi and Soya (Ra:So - 175.6 mg) and lowest in Wh:So - 38.2 mg. The phosphorous content on the other hand was found to be high in Ra:Gg (255 mg) and low in Ra:So (210.6 mg). The highest Iron content was seen in Ragi, Wheat and Soya (Ra:Wh:So - 70.6 mg) and lowest in Rice, Ragi and Green gram (Ri:Ra:Gg - 5 mg).

**Table-2: Proximate composition and mineral content of various CP blends**

C.P. Blends	Moisture	Protein	Crude Fat	Total Ash	Crude Fibre	Carbo-hydrates	Energy (K.cals)	Calcium mg %	Iron mg%	Phosphorus mg%
Ra:So	4.2	15.6	1.4	3.2	4.3	75.6	377	175.6	10.8	210.6
Ra:Gg	4.2	12.0	2.0	2.9	4.0	78.8	381	169.0	14.0	255.0
Ri:So	6.2	19.2	1.3	1.5	1.2	71.7	375	112.0	15.0	235.0
Ri:Gg	6.0	13.1	1.2	1.3	1.3	76.4	377	112.0	44.0	232.0
Wh:So	4.8	22.0	3.0	3.3	2.2	66.9	383	38.2	12.4	252.2
Ra:Wh:So	5.6	18.5	3.2	3.5	3.4	69.2	380	120.5	11.5	230.5
Ri:Ra:So	5.2	15.1	2.1	2.3	2.2	75.2	381	202.0	10.0	228.0
Ri:Ra:Gg	5.9	13.1	1.7	2.5	2.3	76.7	375	132.0	15.0	226.0

### Carbohydrate Profile:

Total sugars ranged from 0.54% to 1.42%. Highest total starch content was found in Ra:So (49.50%) and lowest in Rice, Ragi and Soya (Ri:Ra:So - 24.7%) (Table 3). The soluble dietary fibre (SDF) content was highest in Wh:So (10.8 g) and lowest in Ra:Gg (2.2 g). Insoluble Dietary Fibre (IDF) was high in Ra:So (15.8 g) and low in Wh:So (5.8 g). IDF content was found to be higher in case of blends containing Ragi (Table 4).

### Starch Fractions and Digestion Indices of CP Blends:

The total starch (TS), Starch fractions and Starch Digestion Indices (SDI) are given in Table 5. The readily digestible Starch (RDS) was found to be highest in Ra:So (30.5 g) and lowest in Ri:Ra:So (6.35 g). The Slowly Digestible Starch (SDS) was high in Ri:Ra:So (11.56 g) and lowest in Ra:Gg (1.75 g). An inverse relationship between RDS and SDS contents of the CP Blends was noticed. The Resistant Starch (RS) content was high in Ra:So (10.21 g) and least in Ri:Gg (2.80g). Roasting of the cereals and pulses must have contributed to the RS content of the blends. The TS contents were in the range of 49.5 - 17.66%. The SDI of the blends was calculated from the RDS and TS Values. The blends with higher percentage of RDS were found to have high SDI. Ra:Gg was found to have highest SDI (70.8 g) and Ri:Ra:So had the least SDI (25 g).



**Table-3 Carbohydrates profile of the C.P.Blends (g/100g Moisture Free Basis)**

C.P. Blends	Sugars		Total Starch	Total Dietary Fibre
	Reducing	Total		
Ra:So	0.65	0.81	49.5	19.6
Ra:Gg	0.65	0.81	41.14	18.6
Ri:So	1.07	1.42	32.00	10.4
Ri:Gg	0.61	0.65	35.00	11.6
Wh:So	1.10	1.30	32.04	16.6
Ra:Wh:So	0.82	1.36	36.50	15.6
Ri:Ra:So	0.72	0.82	24.72	10.8
Ri:Ra:Gg	0.40	0.54	45.98	10.8

**Table-4 Dietary Fiber profile of the C.P.Blends (mg/100g Moisture Free Basis)**

C.P. Blends	Dietary Fibre		
	Sugars	Total Starch	Total
Ra:So	3.8	15.8	19.6
Ra:Gg	2.2	16.4	18.9
Ri:So	3.2	7.2	10.4
Ri:Gg	3.6	8.0	11.6
Wh:So	10.8	5.8	16.6
Ra:Wh:So	6.8	8.8	15.6
Ri:Ra:So	0.4	7.4	10.8
Ri:Ra:Gg	3.2	7.6	10.8

**Protein Energy Ratio (PER)**

The PER of the selected three CP blends and casein diet are given in the Table 6. PER values ranged from 2.16 to 2.63. The highest PER was found in Ra:So blend. The food intake by rats was also high in RaSo, as compared with the casein diet.

**Nutrient Density of Enteral Formulations:**

The various CP blends were enriched by addition of Palm Oil and Sugar at 10% levels to increase the caloric density. Nutrients supplied per 100 K cal of the feed are given in Table-7. In general, one part of the feed when constituted with 4 parts of warm

water provided a paste with good flow properties (as judged by viscosity), which is an essential feature of enteral tube feeding formula. The constituted formulae provide 1 K Cal/ml. The feeds providing 1 K cal/ml will have a relatively low osmolality. A total of 350-400 g of feed per day is required to provide 1600-1800 K Cal, 60-70 g protein and 30-40 g fat.

**Table-5 Starch Fractions and Digestion Indices of the C.P.Blends  
(g/100g Fresh weight basis)**

C.P. Blends	RDS	SDS	RS	TS	RAG	SDI
Ra:So	30.5	8.8	10.2	49.5	30.0	61.6
Ra:Gg	20.8	1.7	4.3	29.4	20.8	70.8
Ri:So	9.63	4.7	2.3	17.0	9.6	56.6
Ri:Gg	15.8	6.5	2.8	25.2	15.8	62.7
Wh:So	20.3	6.4	5.3	32.0	20.0	63.6
Ra:Wh:So	21.4	9.5	5.6	36.5	31.0	58.6
Ri:Ra:So	4.5	11.6	6.2	17.7	4.5	25.0
Ri:Ra:Gg	23.0	6.6	3.2	32.8	23.0	70.1

RDS: Readily digestible starch; TS: Total starch; SDS: Slowly digestible starch;  
RAG: Rapidly available glucose; RS: Resistant starch; SDI: Starch digestibility index.

**Table-6 Protein Efficiency Ratio (PER) of the C.P. Blends**

Diet	Protein Source	Protein Content %	Body Weight		Food Intake (g)	Protein Intake (g)	PER
			Initial (g)	Final (g)			
A	Casein	10.2	38.2±1.1	128.7±9.0	312.1±30.1	31.9±3.0	2.80±0.04
B	Ri:Ra:Gg	10.2	36.3±1.6	118.8±3.9	372.7±13.4	38.2±2.4	2.16±0.08
C	Ra:So	9.9	37.6±1.5	120.5±6.7	318.2±20.7	31.5±3.6	2.63±0.11
D	Ri:So	10.1	36.8±1.2	122.3±6.2	324.4±20.1	32.8±3.1	2.52±0.05

In planning any Nutritional Support regime, both energy and nitrogen requirements are to be considered. Tube feedings are generally planned to supply 1 K cal/ml. Enteral feeds can be formulated from processed cereal pulse blends because such blends can take care of most of energy, protein needs of the patients. The nutrient density can be enhanced by supplementing the feeds with concentrated sources of energy, protein, vitamin or mineral as needed by the patient.

Table 7. Nutrients Provided by Various C.P. Blends Per 100 K.Cal.

Nutrients	Ra:So	Ra:Gg	Ri:So	R:Gg	W:So	Ra:W:So	Ri:Ra:So	Ri:Ra:Gg
Energy (K.Cal)	100	100	100	100	100	100	100	100
Protein (g)	3.9	3.1	4.8	4.1	4.6	4.4	3.1	3.0
Fat (g)	3.4	3.1	5.5	3.5	3.7	3.7	2.3	2.7
Total Starch (g)	12.3	10.6	8.0	11.2	9.5	8.7	5.1	10.5
Fiber (g)	4.9	4.8	2.6	3.7	4.5	3.7	2.2	2.4
Calcium (mg)	43.9	43.9	28.0	35.8	6.2	28.9	42.4	42.2
Iron (mg)	2.7	3.6	3.7	3.5	2.7	2.7	2.1	1.1
Phosphorus (mg)	42.1	66.3	58.7	74.2	57.6	55.3	47.8	51.9
Quantity (g)	25.0	26.0	25.0	32.0	23.0	24.0	21.0	23.0
Cost (Rs./100g)	8.0	5.0	6.0	5.0	11.0	10.0	6.0	6.0

The CP blends can be considered superior to the blenderised mixes since the nutritional composition of the blends and their ingredients are known. The diets can be thus tailored/manipulated towards specific needs by adjusting the composition of the CP blends. Also the proportion of carbohydrates, protein and fat in the blends are almost similar to that of the normal diet, which is a pre-requisite of an ideal enteral feed.

From the fibre profile of the CP blends, it is clear that enteral formula have high dietary fibre content. IDF content was higher in blends containing ragi. Adequate fibre content of the CP blends can be helpful in avoiding constipation in tube fed patients. Enteral formulations containing soya fibre could be used in the acute care setting to prevent diarrhea associated with tube feedings. The use of enteral feeds containing fibre has been suggested in elderly, those who require long-term nutritional support and neurological patients with enteral inactivity. The formulations are lactose free and hence may improve gut tolerance and minimize the occurrence of diarrhea.

Starch digestibility indices (SDI) of the CP blends were estimated during the study. Low SDI foods are preferred for patients suffering from metabolic abnormalities such as diabetes and hyper lipidemia. On the other hand high SDI blends are recommended where rapid absorption and utilization of energy is needed such as burns, undernourishment, etc.



The findings clearly indicate that it is possible to formulate enteral feeds based on CP blends. However when sugar and milk are added these, turn out to be palatable

and can be used orally. CP blends with sufficient modifications are suitable to administer naso-gastrically. Cost of such blends is significantly lower than the commercially available enteral feeds and these can be a boon to the poorer sections of people.

### Conclusions

Processed Cereal-Pulse blends can be used in the preparation of formulae suitable for enteral feeding, provided they are supplemented with concentrated sources of energy, protein, vitamins and minerals, as needed by the patient. PER values of the blends were found to be high which indicates that the protein status of the patients can be maintained. From the present findings, it may be concluded that locally available foods can be used to formulate, low cost enteral feeds for nutritional support of the critically ill patients.

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## EVOLUTION AND EVALUATION OF AN INFORMATION PACKAGE FOR CREATING AWARENESS ON PARENTING AMONG PROSPECTIVE PARENTS

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The present study was conducted in Coimbatore city, Tamilnadu. Adopting convenience sampling, 200 prospective parents were selected as sample. The research was conducted in two phases namely - Phase I: Evolution of an Information Package on parenting and Phase II: Conduct of pre-parental awareness programme and evaluation of the Information Package evolved. Questionnaires were designed to elicit the information base of the prospective parents on parenting before and after viewing the Information Package. This apart, a checklist was formulated and administered to the prospective parents to ascertain the benefits of the Information Package. Scores were assigned to the pre-test and post-test responses. The data collected was analysed using paired t-test and ANOVA. The salient findings of the study include: There was significant difference (at 1 % level) in the knowledge gained from the Information Package among four groups of prospective parents in individual parenting dimensions namely Feeding; Health and Disciplining. Married prospective parents gained better benefits than their cohorts and in terms of gender, married prospective fathers acquired more knowledge in comparison to their counterparts.

Children are supremely important asset of a nation. The Indian Council for Child Welfare report (1999) reiterates that providing appropriate foundation and attending to their optimum development is no doubt highly imperative. Sadly, in India, young children meet with challenges that restrict their prospects of holistic development. The harsh reality is that they are deprived of the opportunity to thrive and achieve their fullest potential. The main reason for the prevailing condition is that children are left uncared by parents, who are either ignorant or unaware of their parental roles and responsibilities.

The crying need to provide factual information on parenting to prospective parents in their irreplaceable role as 'father' and 'mother' could be made viable by exploring in-depth, the possibilities of pre-parental awareness. Prospective parents should become aware of their future role before the real burden of parenting descend and before attitude towards one's own children are established. Thus, the challenge of providing a competent pre-parental awareness programme through adoption of advanced technology will make information useful for future practice (Panda and Gang 2002). Efforts taken by professionals on these grounds will ensure positive outcome and provide an array of benefits for participants through increased knowledge and greater involvement in parenting (Campion 1995). Many past research studies too echo the findings that prospective parents have become more knowledgeable about parenting after they participate in the pre-parental awareness programme (Myers 1992; Tinsley 1997; Ptannestiel and Seitzer 1999).

The present study was undertaken with the assumption and concretion that scientific knowledge about parenting if disseminated will expand the vision of prospective parents on parenting issues, enable them to make informed life decisions on parenting, entail them to clarify their parental roles and realize their responsibilities towards children.

The objectives of the study were to develop relevant content on parenting children below two years, evolve an Information Package on parenting, enrich the information base of prospective parents on parenting using the Information Package and evaluate the effectiveness of the Information Package.

### **Materials and Methods**

#### **Operational definition of key terms**

**Information Package:** Comprehensive and interactive computer based Package with contents on parenting issues augmented by appropriate pictures, illustrations, links, sound, animation and visual effects.

**Prospective parents:** Men and women (married and unmarried) who expressed their desire to be future parents/ to-be-parents

**Pre-parental awareness programme:** Programme in which prospective parents learn about parenting from the Information package prior to their entry to parental role in order to get acquainted with the same for later role performance.

This research conducted in Coimbatore city, Tamilnadu, included two categories of prospective parents as sample. The first category comprised of 100 unmarried to-be-parents (50 women students [prospective mothers] and 50 men students [prospective fathers]). The second category comprised of 50 married couples who were yet to become parents (50 husbands and their wives i.e. total of 100). In all, 200 prospective parents were chosen for the study adopting convenience sampling. Prospective parents were selected for the study because in the light of research findings (Clarke and Stewart 1988; Qunn 1997) developmentalists feel that parenting requires considerable responsibility and commitment and hence it is better to orient young people about parenting before its onset.

Kuraishy and Bokkari (2002) and Pachalingappa (2000) reported that computer facilitates faster learning than the traditional method of teaching. Yasmeeen (1991) adds on the over-riding impact of computer technology in making the learning process enriched and enlivened. Cronish (1996) also reiterates the above stated. Since, research findings highlight the fact that computers pave the way for effective and vertical development by providing individualized instruction and interactive learning, it was decided to use computer as a tool for creating pre-parental awareness.

The study was carried out in two major phases.

**Phase I:** Evolution of an Information Package entitled 'Parenting Children below Two Year.



The Package was evolved as per the Computer-Based Tutorial (CBT) model. CBT is a novel approach to enhance learning capabilities of the target group by adopting modern technologies.

Flash, Visual Basic, Adobe Photoshop, Text Aloud MP 3 and Rich Text File were used for the development of the Information Package. The Information Package evolved has special features like 'Quick Tour' (to offer instructions to use the Package effectively and make it user-friendly), 'Quick Browser' (to facilitate direct and easy viewing of the required content without flipping through several screens), 'Interactive Exercises' (flexibility to offer scope for input by user and corresponding output by computer), 'Bookmark' (a record of destination that allows user to view the content desired), 'Glossary' (to get to know the meaning of technical terms used in Package), 'Links' (highlighted bit of text that enables the user to jump to the elaborate textual content), 'Navigational Options' (ability to determine one's own way through the program with the presence of an accessible course map) 'Pop-up windows' (elaborate detail of certain terms used in illustrations), 'Scrolling Text' (to elicit key board operations for all the above mentioned) and audio facility.

The following steps were adhered to in the evolution of the Information Package – Selection of topic, framing of objectives, development of content on parenting children below two years, evaluation of content by experts, programming, screen designing, development of Information Package, testing and development of user-manual.

Phase II: Conduct of the pre-parental awareness programme and evaluation of the Information Package evolved.

Initially, the pre-test was administered to the beneficiaries using a questionnaire developed by the researcher. The questionnaire included various evaluation techniques like 'Choose the best answer', 'True or false statements', 'Agree' or 'Disagree' statements and 'Match the following'. The statements were drawn from all the dimensions detailed in the Information Package. The questionnaire was purposed to assess the existing knowledge of prospective parents on issues pertaining to parenting children below two years, prior to their participation in the pre-parental awareness programme.

Then, the selected prospective parents were exposed to the pre-parental awareness programme. During the awareness programme, they viewed and learnt parenting issues from the Information Package, at their own pace, using the computer.

After their participation in the pre-parental awareness programme, the post-test was conducted, using another questionnaire incorporating the same questions as in the pre-test questionnaire. This was carried out to ascertain the information gain on parenting issues among the beneficiaries. Scoring pattern was adopted to quantify the pre-test and post-test responses. In addition, a checklist formulated to determine the user satisfaction of the Information Package was administered to the sample.

To evaluate the effectiveness of the Information Package in terms of creating awareness on parenting among prospective parents, the scores attributed to the pre-test and post-test responses of the prospective parents were analyzed using the paired t-test. Analysis of Variance (ANOVA) was used to analyse the difference in information gained on parenting among the four groups of prospective parents (unmarried prospective mothers, unmarried prospective fathers, married prospective mothers and married prospective fathers).

## Results and discussion

The salient features of the selected sample are: Majority of the unmarried prospective mothers (66%) and unmarried prospective fathers (64%) were below 22 years of age. As regards married prospective parents, 64 percent likely fathers were more than 28 years old and nearly half of mothers-to-be were between 20 - 24 years of age. As for occupational status, more than one-third married prospective mothers were homemakers. Among those who took up a career, 30 percent were teachers and 12 percent held professional jobs. Of the married prospective fathers, 36 percent were professionals followed by teachers (26%) and businessmen (18%). More than 75 percent of the sample drawn was from nuclear families and in terms of financial status, 76 percent unmarried prospective mothers, 80 percent unmarried prospective fathers and 72 percent married prospective parents had a family income of 1-3 lakhs per annum.

More than half of the participants, before viewing the Information Package, perceived that 'Colostrum' – the ideal food for the newborn, has to be discarded. Research studies by DANIDA (2002) and Kalra et al. (2000) also indicated that mothers were ignorant of the advantages of feeding colostrum. The outcome of the pre-parental awareness programme in increasing the knowledge of the beneficiaries on issues related to feeding young children with colostrum and breast milk is evident from Table 1.

The Information Package had also dispelled the belief among more than three fourth of the prospective parents that commercial baby foods enhance nutritional status. Ninety two percent prospective parents had acquired better idea about supplementary foods, after reading the Information Package in marked contrast to 46 percent prior to using the Information Package. The increase in the knowledge of the prospective parents on feeding practices in children was significant at 1% level. Implying the commendable rise in the awareness score records that the pre-parental awareness programme was beneficial and the Information Package is efficacious.

It is lamented that 72 percent prospective parents had absolutely no idea about appropriate vaccines that have to be administered to prevent the occurrence of specific diseases. Three fourth of the participants had no clue of the timing of administration of these vaccines. Also, more than 60 percent of the target group wrongly perceived that one or two doses of O.P.V is sufficient to prevent polio attack and 57 percent strongly believed that children should not be vaccinated if they were sick (Table 2). Research studies by Peckham et al. (1998); Bennet and Smith (1992); Egan et al. (1993) and Sutton and Gill (1998) project that poor administration of immunization has been linked with the lack of awareness on the part of parents. Studies by Singh and Kang (1998) and Smailbegovic et al. (2003) confirm the above research findings. The significant difference (at 1% level) between the pre-test and post-test awareness scores is indicative of the increase in the prospective parents gain in information regarding immunization after being exposed to the Information Package.



Table 1. Awareness on Feeding Children

Statements	Total Scores			
	Before		After	
	A	%	A	%
The first fluid (colostrum) from the breast should not be discarded	66	33	175	87.5
Children below 6 months of age do not require water	85	42.5	160	80
Breast milk provides immunity	116	58	183	91.5
Baby must suck areola along with nipple while breast-feeding	113	56.5	182	91
Breast-feeding mothers do regain their body shape	107	53.5	178	89
Bottle-fed babies are more prone to diarrhea	98	49	169	84.5
Dilution of water to cow's milk must be 2:1 for 1 month old children	130	65	173	86.5
In artificial feeding, it is better to use a cup than a bottle	65	32.5	157	78.5
In bottle feeding, bottle must be tilted & teat must be filled with milk	79	39.5	176	88
Demand feeding is better than bottle feeding	28	14	43	21.5
Commercial foods do not enhance nutritional status of children	47	23.5	157	78.5
Only 1 new supplementary food should be introduced at one meal	118	59	179	89.5
Strained juices of vegetables can be given as supplementary foods	91	45.5	184	92
The baby can be weaned at 9 months	62	31	150	75
Sucking moderately and tasting eagerly food substances is a sign of readiness for weaning	123	61.5	181	90.5
<b>Total Awareness Score</b>	<b>1328</b>		<b>2547</b>	
<i>Mean</i>	<i>6.64</i>		<i>12.74</i>	
S.D.	2.60		2.14	
t-value	27.71**			

A – Awareness Score

\*\* Significant at 1% level



Table 2. Awareness on Immunization

Statements	Total Scores			
	Before		After	
	Max. 200		Max. 200	
	A	%	A	%
Children should be immunized to prevent occurrence of diseases	142	71	190	95
BCG should be administered within 0 – 15 days of birth	50	25	165	82.5
Administration of MMR vaccine does not prevent Polio	57	28.5	166	83
Children can be vaccinated even if they are sick	86	43	172	86
Administration of all 3 doses of O.P.V is essential to prevent Polio	763	38	165	82.5
Total Awareness Score	411		858	
Mean	2.6		4.29	
S.D.	0.99		1.00	
t-value	26.74**			

A – Awareness Score

\*\* Significant at 1% level

The sample showed tremendous improvement in awareness regarding various parenting styles and their corresponding impact on children after perusal of the Information Package. Nearly half of the beneficiaries reported that 'spanking' and 'depriving food' as effective disciplinary measures, prior to participation in the pre-parental awareness programme. In Indian society perhaps, corporal punishments are justified in the child's best interest by parents. Moreover, widespread indifference to violence or even acceptance of violence as a solution to problems exhibited by children may be the other reason. The Package has successfully intervened by educating 87 percent prospective parents that such corporal punishments threaten the very foundation of healthy development and sense of security rather than holding themselves as effective disciplinary measures.

The Information Package was noted to have uncovered valuable insights for prospective parents on the positive effects of various disciplinary techniques like distraction and withdrawal of privileges. In addition, it had also emphasized and reinforced the need

for parents to persuade children to verbalize their feelings and serve as role models in matters concerned with disciplining. The significant rise in the post-test score (Table 3) after the use of the Information Package augment the above statements and feature meaningful improvement in information gain on concepts pertaining to 'disciplining' among the beneficiaries.

**Table 3. Awareness Score on Disciplining Children**

Disciplining children	Awareness scores of prospective parents								Total Score	
	Unmarried				Married				Before	After
	Mother		Father		Mother		Father		Max :	Max :
									4000	4000
Total awareness	490	891	472	850	554	879	524	896	2040	3516
Mean	9.8	17.8	9.4	17.0	11.0	17.6	10.5	18.0	10.2	17.6
S.D	2.98	1.47	2.84	3.25	3.36	2.56	2.08	2.21	2.90	2.46
t-value	18.73**		11.45**		12.60**		17.88**		28.77 **	

N =50

\*\* Significant at 1% level

A significant difference at one percent level pertaining to the overall information gain on parenting among the four groups (Table 4). The data portrays an increased gain in information on parenting by married prospective parents than by their unmarried counterparts. Perhaps, the need to put into practice the information that they gained through the Package in the near future might have propelled them to more effectively utilize the pre-parental awareness programme.

It is noteworthy that married prospective fathers had gained maximum knowledge from the Package. This clearly focuses the interest and desire of the men folk to become better informed, shoulder equal responsibilities with their spouse and effectively perform their role as fathers. This finding is in tune with that of Pleck and Pleck (1997) study that revealed that social changes force adjustments in both popular and scholarly conceptualizations of mother's and father's role as a parent. This is mainly because, currently, there is greater involvement of fathers in children's lives and hence an increased drive on the part of fathers to be more informed on child care issues.

The beneficiaries had expressed that the Information Package has spurred their confidence towards efficient and competent parenting. Ninety percent had openly agreed that they had realized the roles and responsibilities of parenthood only after viewing the Information Package (Table 5). The efficacy of the Package to relegate unnecessary anxieties and myths associated with parenting which would in turn hamper the

**Table 4. Knowledge Gains on Parenting Issues among Prospective Parents**

		prospective parents				F. ratio
		Unmarried		Married		
Parenting	Mean	Mother	Father	Mother	Father	7.3522**
	S.D.	65.8	64.1	72.2	82.3	
		15.4306	31.25	20.5350	14.77	

N = 50

\*\* Significant at 1% level

parenting potentials were among the other benefits reported by 85 percent and 65 percent of the prospective parents respectively. All the above reflect that the pre-parental awareness programme has been truly wholesome and purposeful.

**Table 5. Feedback on the Pre-parental Awareness Program**

Feedback	prospective parents			
	Unmarried		Married	
	Mother	Father	Mother	Father
Built confidence	100	100	100	100
Improved knowledge	100	100	100	100
Facilitated to identify one's role as a parent	84	76	100	100
Enabled to realize responsibilities of parenthood	86	80	96	96
Dispelled unnecessary anxiety	90	76	94	80
Demystified myths	60	50	78	72

### Conclusion

The findings present insight on the fact that the selected prospective parents had well utilized the pre-parental awareness programme and that the Information Package had set the stage for them to realize that informed, confident and competent parenting is the responsibility of every parent and the right of every child.

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