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STRATEGIES FOR COMBATING FOLATE DEFICIENCY

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Folate deficiency leads to various disorders like intrauterine growth retardation, adverse pregnancy outcome, neural tube defect (NTD), cardiovascular diseases, cancers, depression, Parkinson diseases etc. The deficiency has been precipitated by not only low intake of folate rich foods but also by several other factors like malabsoption, inborn metabolic disorders, poor bioavailability, cooking losses, use of folate antagonistic drugs, oral contraceptives and alcohol etc. Folate status has been indicated either by dietary intake or plasma and red blood cell levels. Recently elevated homocystein level is also considered as an indicator for folate deficiency and its consequent disorders. Folic acid has been found to linked with vitamin B_{12} and zinc. Three approaches have been in operation to combat folate deficiency: dietary modification, supplementation and fortification. Consumption of folate rich foods like fruits, vegetables, cereal grain products and legumes in judicious combination may provide sufficient folic acid but they have low bioavailabilty. Supplements with better absorption capacity are being used in intervention programmes. Fortification is found to be cost effective public health measure with better compliance. It has been made mandatory in some countries to prevent NTD and reduce the risk of other chronic diseases. There are wide variations in the Recommended Allowances in different countries and in different conditions.

Wills (1931) observed a characteristic type of anemia in pregnant women in Bombay in 1931, which differed from anemia due to iron deficiency. She cured the symptoms with a yeast preparation effectively and later she treated similar symptoms with liver extract in monkies. After a decade Mitchell and coworkers (1941) obtained a similar substance from spinach, which was an active growth factor for *Lactobacillus casei* and behaved like a vitamin. They named this substance "folic acid" after a Latin word "folium" as it was found in spinach leaves. Soon synthesis of folic acid was possible. It is a water- soluble vitamin of B-complex group and also referred to as folate, folacin or vitamin B_c with chemical structure of Pteroylglutamic acid (PGA).

Importance of folic acid is associated with the formation, multiplication and maturation of red blood cells, nerve cells and neurotransmitters like dopamine and serotonin. Metabolically it acts as a coenzyme necessary for transferring single carbon unit during trans-methylation and trans-sulfuration pathways. The significance of this vitamin lies in its leading role in formation of nucleotide bases necessary for synthesis of DNA and cell replication. Folic acid has always been considered along with vitamin B_{12} and recently both of them together have been associated with homocystein level in the blood indicating risk of several disorders and vascular diseases (Anon 1989). Folic acid is available in a variety of chemical forms, which governs its role, absorption and utilization in the system. Predominantly, it circulates as 5-methyl tetrahydrofolate (5 Met - THF) in the blood.

The value of folic acid during pre and post pregnancy period in preventing birth defects in newborn is well established. As folic acid is required in cell-division during embryonic and fetal development, deficiency of the same may interfere with intrauterine growth of the fetus and lead to pre-term delivery, low birth weight, fetal growth retardation, spontaneous abortions, placental abruption and pre-eclampsia (McLaren and Meguid, 1988, Scholl and Johnson, 2000). Deficiency of folic acid has always been associated with megaloblastic anemia (enlarged red

blood cells with hyper-segmented nuclei) often manifesting shortly after delivery. More than 20% of the pregnant women particularly those subsisting on sub-optimal diet consuming folate deficient foods face this problem (Metz 1970). He also added that this type of anemia is not common in malnourished adults until conditioned by pregnancy, malabsorption, hemolysis or increased infection and lactation. Several other authors have given similar observations.

Primary deficiency can be diagnosed with fatigue, hair loss, acne, sore throat, anorexia, insomnia, diarrhoea, nausea, constipation, heartburn and increased infections. Lack of adequate folic acid alters the red blood cell formation and DNA replication especially in haemopoietic tissues of bone marrow and epithelial cells of the gastrointestinal tract, resulting in abnormality in folic acid metabolism and a variety of disorders. Herbert (1987) himself as a subject consumed <5 mcg of folic acid per day to assess the sequential changes of folate deficiency. The blood folate level fell within 2 weeks leading to hyper-segmented granulocytes in 12 weeks followed by reduced red blood cell folate level in 18 weeks and megaloblastic anemia in 20 weeks.

Folate deficiency is also common in infants and children. The concentration of folate gets reduced significantly in the liver of infant if the mother constantly has low folate status during 3rd trimester of pregnancy and continues to have low intake even after 2 weeks of lactation. Newborn receives folic acid at the expense of the liver stores of the mother (Mc Laren and Meguid 1988). Among young children the deficiency is easily precipitated by hemolytic anemia, hookworm infestation and malignancies (Mc Laren and Burman 1982). Folic acid was found important in the treatment of kwashiorkor, lack of appetite, edema and reduction in serum albumin as observed by Kamel et al. (1972). Folate deficiency often underlines vitamin B_{12} deficiency because of metabolic interrelationship between the two vitamins. Recent evidence has shown that deficiency of either or both of them are linked with learning disabilities, childhood psychiatric disorders, mental retardation and other developmental disruptions (Scholl et al. 1996). Mark (1993) also opined that hostility and paranoid behavior are often present in folate deficient individuals.

Neural tube defect (NTD): NTD, a birth defect possibly occurs between 15 and 28 days of gestation often before pregnancy is identified. Neural tube develops along the back of the embryo, which later becomes spinal cord and brain of the baby. When tube is not closed properly, the condition is known as "spina bifida" meaning splitted spine. The defect may lead to paralysis of legs, bladder, rectum and other neurological disorders. Later it restricts his work, education, and recreation opportunities and reduces the self-esteem and personal interaction with others. Hibbard and Smithelles (1965) first showed the possibility of involvement of folic acid in the causation of neural tube defect (NTD) as they found low level of folate in plasma and red blood cells among women giving birth to baby with NTD. This led Smithelles group (1980) and Lawrence (1981) to carry out systematic study to find out the role of folic acid in NTD by giving vitamin supplement (0.36 mg / d & 4.0 mg / d) prior to conception. Later, MRC (Medical Research Council) Vitamin Study Research Group of London started a cross sectional, multicentric study in seven countries by taking sample of 1817 pregnancies in 1983 and presented its result in 1991 confirming the significant role of folic acid in occurrence of NTD. Czeizel and Dubas (1992), Werler et al (1993) and Shaw et al. (1995) also opined that folic acid if given periconceptionally prevent first occurrence of NTD. Bower (1995) and Wald and Bower (1995) have also studied the relationship of folic acid in prevention of NTD.

According to the US Public Health Services (1992), approximately 2,500 infants are born every year with NTD in the United States. Karmarkar (2003) recently reported that 1,07,814 infants are born with this defect in India and the incidence varies in different parts of the country and ethnic groups. It was higher in Delhi, Rohtak, Jaipur and Lucknow as compared to Calcutta, Pondicherry, Chennai, Mumbai and Mysore (Agarwal 1998) and particularly in Sikh communities (Baird 1983). Sankar (2002) gave some interesting figures of NTD prevalence in India emphasizing the significant regional variations (Table 1).

TABLE. 1. PREVALENCE OF NTD IN INDIA

Place	Prevalence (no./1000 Live births)
Devangere	11.4
Chennai	2.3
Patna	5.3
Calcutta	1.1
Ajmer	6.6
Rajasthan	8.0
Lucknow	4.7
Delhi	4.1
Chandigarh	12.0
Udaipur	7.8
Jaipur	5.6
Amritsar	8.0

Coronary Heart Diseases: Emerging evidences suggest the beneficial role of folic acid in reducing the risk of coronary heart diseases (CHD). Low folate intake tended to elevate the plasma homocystein level as observed by Tucker et al (1996). The elevated homocystein or Hyperhomocysteimia has been found to be an independent risk factor for vascular or heart diseases (Clarke 1984, Anon. 1989; Boushey et al. 1995 and Brattstorm 1996) and can be reverted by increasing folate intake. A strong inverse correlation between folic acid and homocystein was also observed by Kilner (1998), Koehler (2001) and Gonzalez-Gross et al (2002). But according to Shaw and Bhagwat (2003) low folate intake is common in general population especially elders leading to a rise in homocystein level but not always precipitating in CHD. There are patients receiving some folate antagonist like methotrexate or carbamazine, which tends to disturb homocystein metabolism resulting in vascular endothelial cell damage and platelet aggregation.

According to Newswire (2003) folic acid consumption reduces the risk of heart disease by 16 %, blood clot 25 % and stroke 24 %. Brown (2001) observed that folic acid along with n-3 fatty acid and vitamin E is associated with CHD because they have an effect on vascular endothelial cells. Many clinical trials are underway to see if folic acid can be an independent factor in reducing the risk of CHD (Wilson 2002).

Depression: Depression was observed in individuals with low dietary intake of folic acid followed by low circulating blood folate level. Folic acid deficiency occurs in 30 % patients with depression, 24 % with psychosis and 20 % with schizophrenia (Carney 1967). Young and Ghadirian (1989) reviewing different studies reported consistency in relation to folate deficiency and depression and schizophrenia cases. The deficiency was 40 % more in alcoholic patients (Carney et al. 1990). Evidences are there that oral administration of folate compound results in improvement in their cognitive functions, mood and speed of mental processing. Coppen and Abou-Saleh (1982) treated depression with only 0.2 mg folate for one long year, but Godfrey et al. (1990) used very high dose of folate (15 mg 5 methyl tetrahydrofolate / day) for few weeks only. Role of both folate and vitamin B_{12} in depression, dementia and other neurological and psychological disturbances especially in older population is well explained by Bottiglieri (1996), Parnetti et al. (1997), Reynold (2002) and Tolumen et al. (2003). Bhakru (1998) suggests that 5 mg folic acid three times per day could completely reverse mental symptoms in some individuals. Thus there is no consistency in the dosage of folic acid used beneficially for treating depression.

Alzheimer and Parkinson's disease: Elevated plasma homocystein level has been observed in patients with neurological disorders due to folate deficiency. Homocystein is required to form methionine that is needed for the synthesis of S-adenosylmethionine (SAM), which rapidly metabolizes back to homocystein. SAM is low in patients with Alzheimer dementia. Oral administration of the same for 3-5 months showed improvement in cognitive function, mood and mental processing (Reynold et al. 1989). Elevated plasma homocystein mediated by folate deficiency is associated with Parkinson's disease, which is mainly due to the nerve cells dying or becoming impaired to produce dopamine. Lack of dopamine leaves the person unable to control his motor movements. Folic acid reduces the chances of damage to dopamine producing neurons (Duan 2002, Miller 2002).

Cancer: Cancer is caused by damage to the genetic material DNA. Recently, Blount and Ames (1995), Blount et al. (1997), Choi and Mason (2000) and Duthie et al. (1999) have explained the relationship between folate deficiency and DNA damage and its role in carcinogenesis. Thymine, a pyrimidine base essential for DNA synthesis is largely dependent on folic acid which is also is necessary for creating "S phase" for normal cell division. In the absence of folate enzymes, normal cell division is hampered resulting in chromosomal breakage and in the absence of thymine, DNA tries to use another pyrimidine base known as "uracil" to complete its synthesis. DNA formed through uracil is vulnerable to virus, carcinogens and mutagen insertion. Folic acid prevents chromosomal breakage and the increased incorporation of "uracil" into human DNA and thus reduces the risk of cancer. Women consuming alcohol regularly could prevent themselves from breast cancer by taking at least 600 mcg folate per day Zhang et al. (1999). Folate supplementation during pregnancy reduces the risk of lymphoblastic leukemia in children (Thompson 2001) and also protects against Down's syndrome (Gad Baekai 2003).

Indices for assessing Folic Acid Status: Low folate concentration in serum or plasma and erythrocytes or red blood cells provide strong evidence for folate deficiency and is widely used to assess the folate status in different population. It indicates that plasma folate concentration is more influenced by dietary intake thus less reliable. Red cell folate level indicates body store and is more accurate to detect folate deficiency (Sauberlich 1999). Red cell folate for normal individuals was reported to be in the range of 166 - 640 ng / ml and it was 25 - 540 ng / ml for non-anemic folate deficiency, 8 - 143 ng / ml for megaloblastic anemia and 26 - 395 ng / ml for pernicious anemia (Hoffbrand et al. 1966). Acceptable plasma folate level for all ages is 3.0 - 5.9 ng / ml and

below 3.0 represents deficient level. According to WHO (1972), serum folate level < 3.0 ng / ml and red blood cell level < 100 ng / ml indicate folate deficiency. As per the norms for serum folate about 71% school children, 49 % pregnant women and 65 % obese children from Poland were at risk for folate deficiency (Wartanowicz et al. 1990). Folate deficiency is prevalent in 30% women (18 - 29 years) in France (Costa de Carvalho 1996) and 13 % in women aged 20 - 40 years in Netherlands (Brussaard et al. 1997). Women having red cell folate concentration < 150 mcg / l are at 8 times higher risk of bearing child with NTD (Gonzalez-Gross et al. 2002). Earlier studies evaluated folate status by increased urinary excretion of forminoglutamic acid (FIGLU) in folate deficient subjects. This excretion is further increased after oral load of L- histidine (2 – 25 g) (Chanarin 1964). Now it is seldom used. Homocystein concentration in plasma is considered to be a biomarker for nutritional deficiencies particularly folic acid, vitamin B_6 and B_{12}. In case of deficiency of the vitamin or folate enzyme, homocystein gets accumulated in the blood resulting in elevated homocystein level in plasma. According to WHO (1972) 13.6 nmol / l is considered normal and above 15 nmol as risky. It can increase to > 100 nmol / l indicating severe risk for different chronic conditions. Thus homocystein level increases in plasma in folate deficient subjects, but the same lowers down with administration of oral folic acid (Clarke 1998). Elevated homocystein is commonly observed in elder population and patients with neurological disorders and chronic heart diseases (Anon 1989, Pancharunitti et al 1994, Boushey et al 1995, Tuckler et al 1996, Brattstorm 1996 and Bates et al 1997). Low folate status in circulating blood alone can be a critical factor indicating risk of NTD. It is not only red cell folate level, which is low in women producing NTD babies but also high plasma homocystein level in the same women. 62 % women in Poland showed risk for hyperhomocysteinemia (Wartanowicz et al. 2001) and 11% subjects in Finland (Alfthan et al. 2003).

Dietary intake of folic acid

Folate intake can also be used to assess the folate status in different population groups. Folate intake according to National Institute of Nutrition was found to be low particularly in pregnant and lactating mothers. Only 38 % and 33% of them consumed RDA for folate i.e. 400 mcg for pregnant women and 150 mcg / day for lactating mothers respectively (Bamji 2000). In the United States, according to National Health and Nutrition Examination Survey (NHANES II), the mean folate intake of non pregnant women was 207 +_2.9 mcg / day as against the RDA of 180 mcg / d) but during pregnancy about 90 % women with the same amount per day were said to be consuming only 50 % of RDA as RDA is high (400 mcg / d) (Subar et al. 1989). However, during NHANES III (1988 -1994) and CSF II (Continuing Survey of Food Intake by Individuals, 1994-1996) carried out by USDA's Center for Disease Control and Prevention covering 15000 persons of all ages from 81 countries across the United States, the mean folate intake by women of 20 - 49 years was reported to be 718 mcg and 644 mcg / d DFE (dietary folate equivalent) respectively (Lewis et al 1999). Both the survey reports showed more than 27 % women to be consuming >400 mcg / d folic acid and elderly population lesser amount. The mean folate intake in Netherlands was reported to be 182 ± 119 mcg per day as against their RDA of 200 mcg, on the basis of Dutch National Food Consumption Survey in 1992. It showed that 54 % women and 42 % men did not meet their requirement for folates. Pregnant women consumed 54 - 315 mcg per day without supplements (Brussard et al 1997 and Konings et al. 2001). In Germany, a survey between 1997-2000 showed that the median intake of folates in adult population to be 250 mcg / day as against 320 mcg / d of the estimated average requirement (EAR). Intake among males edges over females. EAR during pregnancy and lactation is higher i.e. 520 and 450 mcg /d respectively taking into account the intake of fortified food also. In Israel, according to National

Health and Nutrition survey, 94 % women of child bearing age consumed < 400 mcg and 50 % consumed even >200 mcg folic acid (Kaluski et al. 2002). Mean dietary intake of folate by Finland men and women was reported to be 241 and 205 mcg / d respectively as against the RDA of 300 mcg / d (Alfthan et al. 2003).

The low folate intake was found to be common in developing countries for variety of reasons. It is also a problem in industrialized countries because of its life-style with decreased physical activity, high intake of refined food and limited intake of vitamins due to low availability through processing, cooking and storage. Thus it is not always the low dietary intake of folate rich foods but there are other factors too, which are responsible for folic acid deficiency. Socio-economic status (Bailey et al. 1980), geographical regions (Bates et al. 1997) and ethnicity (Subar et al 1989 and Chandalia et al. 2003) influence dietary intake for folate. Lack of availability or accessibility of fresh foods further deteriorates the condition. The requirements differ according to age, sex and physiological conditions like pregnancy and lactation. But intake is not increased proportionally and deficiency sets in. Herbert (1962) assessing the minimum folic acid requirement suggested that only 50 mcg folic acid is required per day to check megaloblastic anemia. Health and Welfare committee (1990) recommends 3.0-mcg folic acid per kg body weight. FAO / WHO (1984) indicated 50 % bioefficacy of folic acid. However, most countries suggest for adult population an intake in the range of 100 - 400 mcg to compensate for the cooking losses and poor absorption. Around pregnancy, most authorities have advised 400mcg/d intake of folic acid globally. During aging, low folate status is not because of only poor intake but also because of impaired absorption (Webster and Leening 1979, Mukherjee 1984). Absorption is largely influenced by the chemical nature of folate. Monoglutamyl form of folate routinely found in supplements and fortified food perform better in reduction of NTD for its better absorption through jejunum (Davis et al. 1995, Pfeiffer et al. 1997, Lewis et al 1999, Scholl and Johnson 2000, Kaluski et al. 2002). However, there is limited data for protective effect of polyglutamate form predominantly occurring in natural source of foods. Boddie et al. (2000) also could not find significant difference in absorption of two forms of folate in healthy non-pregnant women with the history of NTD affected pregnancy. The deficiency is also precipitated by hemolytic anemia, mal-absorption (sprue, Crohn's disease) and metabolic disorders, smoking and alcohol consumption (Jeejeebhoy et al. 1968, McLaren and Meguid 1988). There are number of drugs which are folate antagonists and inhibit its absorption and utilization. Some of them are methotrexate, pyrimetamine, triamterene and trimetrexate, phenytoin, sulfasalazine (Stockstad and Jukes 1987, Linder 1999, Daphne 1991& Kapoor 2001). Long-term users of oral contraceptives have been found to show low folate status (Pietarinen et al. 1977). Adverse effect of alcohol on folate status has been reported by McLaren &Meguid (1988).

National strategies to improve folic acid consumption:

Three approaches to upgrade folate status among different population have been devised by Center for Disease control and Prevention and PHS (1992), American Dietetic Association (1994), FDA (Food and Drug Administration) (1998), American Heart Association (2004), Kaluski (2000) from Israel and Gonzales Gross et al. (2002) from Germany and many others from different continents. They are (1) Dietary modification (2) Folate supplementation (3) Food Fortification with folic acid. It is fundamental to improve dietary habits in addition to the proposed dietary supplementation and fortification of food. Evolution of a national policy in this regard is an important public health issue.

Dietary modification: The food-based approach is more acceptable and affordable but characterized by cultural, religious, social and individual food habits and practices of procuring and preparing the food. There are large variety of foods available, which supply adequate amount of folic acid like green leafy vegetables, oranges, citrus fruits, cereal products and legumes. Irony of the vitamin is that it gets lost during processing and cooking in acidic medium. However, some folic acid gets synthesized in gut flora in the presence of pro-biotic organisms. Megaloblestic anaemia is rare among children who consume one fresh fruit or vegetable or drink fruit juices every day (Herbert 1981). PHS (1992) recommended that women of childbearing age especially when planning pregnancy should follow dietary guidelines such as increased consumption of fruits and vegetables for additional folate intake. Sammon et al. (2003) also advised mixed fruits and vegetable concentrates to increase plasma folate and reduce homocystein. Consumption of five servings of fruits and vegetables especially citrus fruits and tomatoes daily would help in consuming required amount of folic acid and reducing the risk of some chronic diseases (American Heart Association 2004).

For US population, dried beans, green leafy vegetables and fortified cereals were the main sources of folate as per Subar et al. (1989) but Scholl and Johnson (2000) reported orange juice as the largest source for them contributing 10 % of dietary folate along with above mentioned food stuffs. Bailey (1990) put tea and beer among first ten good sources of folic acid. In Israel, there is wide consumption of whole wheat bread, potatoes and dairy products, which are moderate source of folic acid and the women receive folate from cucumber and tomato (Konning et al. 2001). Bread and pastries followed by fresh vegetables were found to be the main dietary sources for folate in German population of all age groups except 10-14 years. Nonalcoholic beverages for females and beer for males of this age group were the secondary source of food folate (Gonzalez-Gross et al. 2002). Finnish population consumed 12 % vegetables, 11 % whole meal rye bread, 10 % fruits and 10% potatoes for dietary folate (Alfthan et al. 2003). Indians depended on a wide variety of foodstuffs assuming that a nutrient is not present in isolated form but in combination with many other nutrients and non-nutrients which have synergistic impact - beneficial to health. Rao et al. (2001) found that higher consumption of green leafy vegetables before 28 weeks of gestation led to increase in RBC folate level and birth dimensions of the newborn except skin fold thickness. However, consumption of these are low in most countries.

Bioavailability of dietary folate is not more than half of monoglutamate (Anon 1990). Utilization is inadequate in cases of B_{12} deficiency or large amount of methionine and glycine consumption (Shane and Stokstad 1985 and Linder 1991). It is reported that consumption of 1g of non-starch polysaccharides (fiber) may increase serum folate by changing the intestinal environment where microbial synthesis of folate may occur (Hougton et al. 1997).

There is lack of appropriate data on bioavailabilty of individual food item with wide variation (Tamura 1997). Tamura and Stockstad (1973) reported that bioavalability of endogenous folate from banana is 82 %, cooked lima beans 70 % and orange juice 35 %. Babu and Srikantia (1976) found the bioavailability was 46 % from banana, 63 % from spinach and 37 % from tomato. Later Tamura et al. (1976) showed orange and other citrus fruit juice to be a better dietary source owing to the presence of 5 Met-THF. Folate in yeast, legumes, vegetables have represented conflicting reports regarding its absorption and utilization in human subjects (Gregory 1989). Folates in milk of all species are largely associated with its folate binding proteins. Colman et al. (1981) detected a milk factor that facilitates uptake of folate by intestinal

cells. Folic acid from human is better absorbed than cows or goad milk as type of milk affects intestinal synthesis of folate, according to Samchuk et al. (1994). They also presumed that pasteurization does not affect the bioavailability of milk but boiling reduces it. Ottaway (1993) reported only 5 % loss though pasteurization and 20 % by ultra heat treatment (UHT) and if this milk is stored for three months there is loss of over 50 % folate. The author also suggests that pH <5, sunlight (ultraviolet radiation) has serious effect on stability of folic acid. There are several reports on cooking losses of folate in different food items and different cooking techniques. There was 30 % loss in bread and 80 % in pasta (Pfeiffer et al. 1997) and 30 - 50 % cooking losses (Konning et al. 2001). Latter has also observed increase in folate content by 11 - 15 % in cooked cauliflower and carrot. There was not much difference in microwave and conventional method of cooking of folate rich foods. However, water to vegetable ratio and cooking time are critical in losses of folic acid (Klein et al. 1979, 1981).

Supplementation: After the advent of synthetic form of folic acid, its consumption could be improved at any point of time and it has made research much easier to pin point its role and efficacy in metabolism and DNA synthesis. A supplement of 5 mg / d during pregnancy was found effective to prevent megaloblastic anemia and supplementation significantly reduced FIGLU (formiminoglutamic acid) excretion which usually increased (>7.0 mg / 24 hrs) in folate deficiency (Metz et al. 1965). Later Metz (1970) proposed that healthy women require only 50 mcg folic acid per day and only lactating mothers with low folate diet require 200-300 mcg / d folic acid to increase the milk folate. Larger dose might be higher for women consuming normal diet of fruits and vegetables or women with pernicious anaemia. Folic acid @ 300 mcg / d may be enough for liver storage in infant. Colman et al. (1974) also gave 300 mcg / d in tablet form and found significant rise in red cell folate level.

In India, distribution of iron folate tablets during pregnancy to meet the increased demand was popular since 1970 through National Anemia Prophylaxis Programme. The prophylactic dose was 500 mcg folic acid along with 60 mg iron for pregnant women and 100 mcg folic acid with 20 mg iron for lactating mothers. Later Indian Medical Research Council (ICMR) Task Force study 1999 revised the dose and coverage. Distribution of iron folic acid tablets (IFA tablet) covers pregnant and lactating women, family planning acceptors and children 1-11 years. Pregnant women receive the supplements for more than 90 days through primary health center (PHC) and Integrated Child Development Services (ICDS) in different states of the country (Vijayaraghvan 2001). Weekly supplementation of the same to adolescent girls was also decided to control anemia and thereby improve birth weights of their children. ICMR has also supported the role of periconceptional folic acid supplementation.

Supplementation containing 0.36 mg / d, and 0.40 mg / d and 0.80 mg / d of folic acid along with other vitamins was tried out by Smithells et al. (1980), MRC (1991) and Czeizel and Dubas (1992) respectively. Supplementation when given periconceptionally could prevent occurrence and reoccurrence of NTD successfully (Anon 1990) and 72 % women had lower risk of NTD (MRC 1991). Cuskelly et al. (1996) found dietary folate (approximately 200 mcg / d) when supplemented with additional 400 mcg / d folic acid for 3 months could significantly increase the red folate concentration.

An effective dose which could reduce 20 - 40 % cases of NTD by restoring red cell folate and normalize homocystein (>16.3 mcg) was 100 - 200 mcg / d according to Daly et al.

(1997). To normalize plasma homocysteine level, Ubbink et al. (1993) gave daily supplementation of folic acid @ 1.0 mg / day along with 10 mg pyridoxal and 0.4 mg cynocobalamin for 6 weeks. Clake (1998) gave 400 mcg / d folic acid to 5'10'methylene tetrahydrofolate reductase deficient people. Latter enzyme plays a role in folic acid metabolism resulting in inborn metabolic error or gene mutation leading to wide range of disorders from birth defect to heart disease and cancer). Boddie et al. (2000) pointed out that supplements or fortified foods contain monoglutamyl form of folates, which has link with NTD. Folate in natural form is predominantly polyglutamyl. When the use of supplements in US increased as a result of national folic acid health campaigns, changes in serum folate concentration was observed in Southern California study and Framingham Offspring and NHANES studies (Quinliven and Gregory 2003). Supplementation of iron folate (30mg iron and 175 mcg folic) in Korean women supported the fetal growth, birth weight and birth height (Lim 2003).

Supplements unfortunately, appear to be used least by those who need them most. Its use is influenced by ethnicity, maternal confidence and easy availability. They are generally used more by women of >16 years. Iron-folate supplements (400 -1000 mcg) inhibited intestinal absorption of zinc and sometimes resulting in adverse pregnancy outcome (Mukherjee et al. 1984 and Milne et al. 1984). Simmer et al. (1987) reported impairement of zinc absorption by iron - folate supplements because of requirement of zinc in DNA synthesis. Usually zinc is not prescribed along iron folic acid supplements. But Kalra (2003) has confirmed the interrelationship among folic acid, vitamin B_{12} and zinc.

Colman et al (1975a, 1975b) observed 30 – 60 % bioavailability of folic acid when added to maize, rice and bread and addition of synthetic form provided sufficient protection. Margo et al. (1975) used 900 mcg folic acid / bread slice in order to get 300 mcg folic acid which was comparable with 300 mcg folic acid tablet. They stressed the effectiveness of supplementation and folic acid fortification. Cuskelly et al. (1996) reported its effectiveness in increasing the red cell folate level. According to Godfrey and Oakeley (1999), Jacques et al. (1999) and Anon (2001) supplements of B-vitamins containing folic acid substantially lower plasma homocystein level and reduce the risk of heart diseases. Use of crystalline folic acid in supplement wins over food folate for its higher bioeffeciency Rosenberg (1999).

Fortification: Food fortification is one of the widely accepted approaches to improve nutrition profile of single nutrient as a public health preventive measure. World Bank (1994) approved food fortification as a sustainable and cost effective method of alleviating micronutrient deficiency even among poor and illiterate population. Micronutrient Initiative (MI) (1998) from India also supports this. Salt iodization is an excellent example, which had started in 1922 in United States and is being followed in most countries to prevent iodine deficiency disorders even today. Fortification with other nutrients especially vitamin A and iron have exhibited spectacular performance in reducing the nutritional deficiency diseases like night blindness and anemia. US President, F D Roosevelt, in 1943 mandated enrichment of corn, rice and wheat flours with thiamine, riboflavin, niacin and iron. The Joint FAO/WHO Expert Committee on Nutrition (1971) suggested that food fortification programme must identify the target group, need for nutrient, suitable vehicle and defined toxicity level. Coleman et al. (1974) chose maize (porridge) as suitable vehicle for African Negro. The addition was cost effective and the product had a shelf life of six months at ambient temperature. The improvement in red cell folate using fortified maize meal porridge (@1gram crystalline PGA to 30 Kg maize meal blended for 12 hours (one serving = 30g) was comparable to synthetic folic acid in tablet form (300 mcg). Later in 1975 they studied

absorption of fortified staple food and prevention of folic acid deficiency in pregnant women using the same. In 1982 Coleman used addition of folic acid to staple food as a nutrition intervention strategy.

Smithells et al. (1980), MRC (1991) and Czeizel and Dubas (1992) again proposed fortification of national food supply to prevent risk of NTD. The possibility of fortifying the cereal products with folic acid had some complicated legal and scientific issues. After a decade, Food and Drug Administration (FDA) reconsidered the fortification issue and looked at it in the light of lowering the RDA from 400 mcg to 200 mcg per day to have a check on excess. The National Academy of Science recommended additional studies on folate intake prior to pregnancy (US PHS Recommendation (1998). Gredline et al. (1999) suggested that fortification even with low amount of folic acid make difference in preventing NTD.The US Public Health Services (PHS) (1992) proposed that all women of child bearing age should consume at least 400 mcg folic acid / day to reduce the risk of NTD during pregnancy and suggested that some grain food products must be fortified with folic acid @ 140 mcg /100 g. PHS also cautioned that folate intake should not go beyond 1000 mcg / day except under physician's supervision for safety purpose. Thereafter, FDA (Food and Drug Association) has proposed the fortification policy in the Federal Register in 1993, to authorize a health claim "folic acid for reducing risk of NTD". On January first, 1998, the U.S. Food and Drug Administration (FDA) announced that folic acid or PGA (the synthetic and oxidized form of folate) must be added to the staple foods like enriched flour, breads, corn meals and macaroni. Scientific observations of Metz (1995) on western folate supply (150 - 200 mcg / day), Daly (1997) on effective dose to reduce NTD (100-200mcg/d) and Pfeiffer et al. (1997) on better absorption of folate from fortified foods supported the fortification. Alberson et al. (1997) suggested fortification raised the role of breakfast cereals and ready to eat products in Western countries especially among women of 15-50 years (Table 2). Fortified breakfast cereals were found effective in reducing plasma homocystein level and help patients with heart diseases (Malinov et al. 1998). Thus fortification was suggested to deal with high risk for hyperhomocysteine and congenital anamolies among women (Wartanowicz et al. 2001).

TABLE 2. FOLIC ACID FORTIFICATION LEVEL USED IN DIFFERENT COUNTRIES

Country name	Folic acid (mg/Kg)	Vehicle for fortification
El- Salvador	1.30	Wheat flour
Guetamala	0.35-0.45	Wheat flour
Nambia	0.37	Maize meal
South Africa	2.00 and 0.22	Margarine and Bread
Zambia	0.55 and 0.22	Maize meal and Bread
Bolivia	1.50	Wheat flour
Columbia	1.54	Wheat flour
Maxico	1.60 - 3.20 and 0.40 - 0.80	Wheat flour and corn flour
India	None	None

Source: USAID 2000.

Following folic acid fortification several studies came up for its effectiveness and safety. According to Jacques et al. (1999) mandatory fortification of grain products made substantial improvement in folate status among middle and older people. Prevalence of low folate status decreased from 22.0 – 1.7 % and elevated homocystein also decreased by 40-50%. In Germany 25 % folate is coming from fortified foods (Gonzalez-Gross 2002). Choumenkovitch et al. (2001 and

2002) carried out the study after mandatory fortification in the same subjects of Framingham Offspring Study and observed much higher increase in serum or plasma folate concentration fortification. Folate intake exceeded the prediction. which was that fortification might increase the intake by 100 mcg / d (Lewis et al. 1999, Lawrence 1999 and Hertrampf et al. 2003). It was also observed approximately 0.5 to 5 % US adult population was consuming > 1000mcg folic acid per day (maximum limit for fortification protocol) and it was mainly due to consumption of breakfast cereals which are either over fortified or often consumed more than the serving size given on label as per Rader et al. (2000). Since young women in United States and United Kingdom are electively exposed to chronic fortification. The study of Geraldine et al. (1999) reveals that if women were excluded from fortified food, their folate intake might be decreased by 78 mcg /d and their red blood cell folate concentration fall down. Honein et al. (2001) reported 19% decrease in NTD occurrence after national fortification but they have also suggested that data on NTD prevalence might be incorrect because of incomplete information on birth certificates. According to a study by McKay et al. (2000) multivitamin/ mineral supplement improves plasma vitamin status and lowers homocystein level in older adults but fortification was reported to mask vitamin B_{12} deficiency among them (Hirsch et al. 2002). Thus Oakley (1997) had proposed addition of vitamin B $_{12}$ during fortification. Wald et al. (2001) also favors nation-wide food fortification program as a best way to increase the folic acid intake of the general population but current level provides too little folic acid for homocyteine-lowering benefits to reduce high risk for ischemic heart disease. They believe that dose of 0.8 mg of folic acid daily to these patients would be beneficial.

Cereal fortification has shown significant improvement in folate intake among people (Albertson et al. 1997 and Brown et al 1997). Quinlivan and Gregory III (2003) reviewed the intervention studies and found that the increase in folate intake is approximately twice the FDA prediction (100mcg/d). It might also be due to ongoing folic acid national health campaign. Thus fortificant level in breakfast cereals must be carefully assessed. Solon (2003) also proposed intensive research in terms of product development and sufficient dissemination of information at different level is necessary for sustainable and successful fortification programme. Saraswati (2000) from MI, had reason out that if right food selected, high coverage is assured without requiring a change in the eating habits of the consumer. The organization has also explored the new strategies to reach rural or remote area though public distribution system. Further, Sankar (2002) from MI talking on the "Role of mandatory flour fortification policy lessons from India" suggested flour fortification with SFA (Synthetic folic acid), supplements of SFA and dietary measures to increase natural folate (NF). Currently there are various food products, which have been fortified with some other food item to enhance the nutritive quality of the product, for example, wheat or bengal gram flour is fortified with soy flour to increase the protein quality. In India, Shintre (2000) used premixes for fortification of cereal flours at industrial as well as small-scale chakki or flourmills. He tried premixes named Hexavit FF-02 and Premix code SS-02, which he claimed to provide high % of RDI at reasonable cost and also suggested PFA amendments to include folic acid for fortification in flours to prevent anemia.

Safe levels of folic acid

Chanarine et al. (1960) first reported that high doses of folic acid might interfere with effectiveness of anticonvulsant medication. Later Hunter (1970) observed some mental changes, sleep disturbances and gastrointestinal symptoms in persons consuming >15mg /d folic acid for

about on a month but Sheehy (1973) observed one interesting case that one individual who was consuming very high folate intake (60mg/d) and showed no apparent toxic effect. However, pharmacogically, oral consumption of PGA is generally considered to nontoxic even at the dose of 15mg/d in normal human beings but may cause some neurological injuries in patients with undiagnosed pernicious anaemia or vitamin B_{12} deficiency (Butterforth 1989). Above studies reported also suggests folic acid is a water-soluble vitamin, sensitive to a variety of stimuli and affected by several circumstances and physiological conditions. All these may play role in its effectiveness as well as toxicity.

Conclusion

Folic acid deficiency is common in both developing and developed countries. Need for folic acid supplementation is globally accepted for not only improving intrauterine growth and healthy birth of the child but also reducing the risk of coronary heart diseases, neurological disorders and certain cancers. Recommendations for improving dietary intake of folate rich foods are there but strategies involving use of medicinal folic acid vs. folic acid fortification of food items are still an issue for public health for various reasons. Varied recommendations and assessment methods of folate status in different countries further complicate the issue of designing any national strategy. Though fortification has been found better approach for better compliance as a preventive measure, there are many questions raised. Consumption of extra dose of folic acid by non-target population, which has been observed through post fortification studies, poses another issue to be considered. On the other hand, increasing use of anti-folate drugs, oral contraceptives, smoking, alcohol and higher incidence of CHD, cancers and other neurological disorders further call for the need for folic acid along with vitamin B_{12} and zinc. Thus considering all faces of the governing factors and the consequences of folate deficiency, there is a need to evolve a national policy to improve the folate status and reduce the risk of birth defects and chronic degenerative diseases.

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IMPACT OF INTERVENTIONS ON THE NUTRITIONAL STATUS OF PRESCHOOL CHILDREN

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The investigation was undertaken to study the effect of dispensing supplements in the form of food and nutrients and evaluate the impact on nutritional status on completion and withdrawal of interventions. A total of 205 children from rural areas of Mysore were enrolled. Mothers were interviewed to assess socio-economic status and dietary intake of children. Weights, heights and hemoglobin status were assessed by standard techniques. Children were divided into five groups of 30-50 each for intervention programmes. Two groups were supplemented with biscuits fortified with calcium, iron and vitamin A, another two groups received the fortificants in the form of synthetic nutrients on alternate days for a period of 6 months. One of the two groups in both the categories was priorly dewormed. One group without supplements served as control. On completion of intervention an increase in the heights and weights was observed in all the groups. Prevalence of anemia showed a significant decline in intervention groups as against an increase in the control group. Bitot spots completely disappeared in the nutrient groups but showed an increase in control group. Six months after withdrawal of interventions slight changes occurred in the anthropometric indices, Bitot spots reappeared in all groups, hemoglobin status showed deterioration in all intervention groups but to a significant extent in the nutrient supplemented groups. Supplementation in the form of food or nutrients improved the nutritional status, which got reverted to the deficiency states 6 months after withdrawal indicating the importance of sustenance of interventions. The study also indicated the essentiality of reassessment of impact of nutrition interventions after withdrawal.

Key words : Fortificants, preschool children, malnutrition, hemoglobin, interventions.

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Early childhood malnutrition encompassing both macro and micronutrient deficiencies is considered a major public health problem worldwide with a major representation from south Asian countries for which India is not an exception as confirmed by national and regional surveys (Rao et al. 1980, FNB-UNICEF 1981, Seshadri and Mittal 1985, NNMB 1995). Dietary inadequacy was identified to be the immediate cause of both macro and micronutrient deficiencies. Nationwide diet surveys have reported that quality of dietaries of preschoolers was poor meeting $1/3^{rd}$ to$1/4^{th}$ the requirement of micronutrients (Reddy 1971, Devadas and Saroja 1980, Khamgoakar et al. 1990, UNICEF, 1990, NNMB, 1995). Hence food based approach was considered rational, appropriate and sustainable to combat the deficiencies. Efficacy of food supplements over the synthetic ones is highly controversial (Chandrashekar and George 1991). Several investigators have demonstrated multinutrient supplementation to be more effective to combat multinutrient deficiencies prevalent among the rural preschoolers (Meija and Chew 1988, Underwood 1996). Research has consistently shown that nutrient supplementation elevates the level of the respective nutrients in the serum but the information on the maintenance of the elevated levels after withdrawal of the supplements are scarce. Hence the present investigation was undertaken with the objective of designing an intervention programme (based on nutritional status) in the form of food and nutrients over a known period and evaluating their impact on the nutritional status on completion of interventions to know the effectiveness of supplements and six months after withdrawal of supplementation to observe the sustenance and efficacy of food and nutrient supplements.

Materials and Methods

This was a longitudinal study of 2 phases namely (1) selection of subjects, assessment of nutritional status and planning of interventions and (2) intervention dispensal for 6 months with an inbuilt evaluation component. 205 children (1-5 years) from rural areas near Mysore city were selected by purposive sampling. Mothers of the children were interviewed to elicit information on socio-economic status. Dietary intake of the children was obtained by 24-hour recall method in three different seasons of the year and nutrient adequacy was computed by comparing the intake data with RDA for age (Gopalan et al. 1996).

Assessment of nutritional status

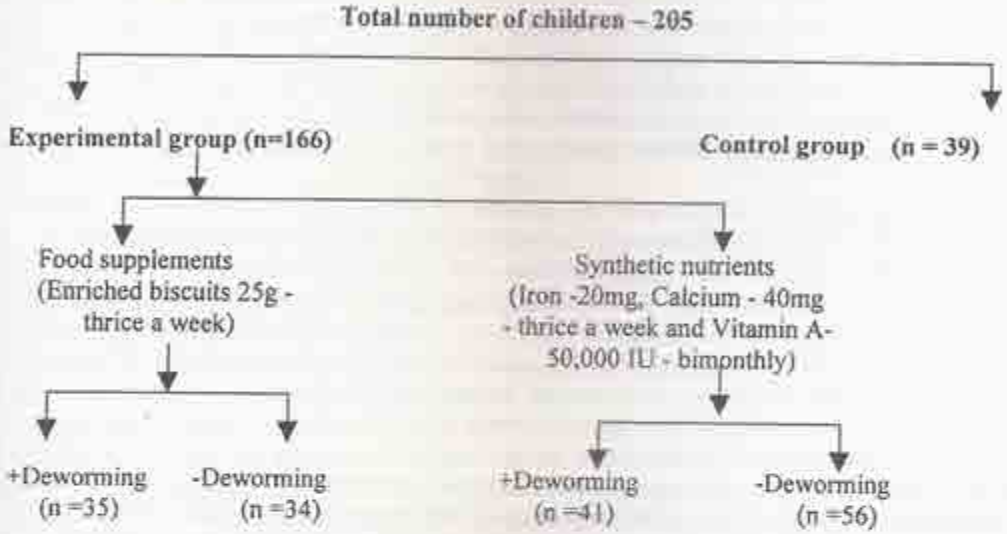
Weights of the children were recorded using a portable spring balance to the nearest 0.5kg and heights were measured using a fiberglass tape to the nearest 0.1 cm by standard techniques. The recorded weights and heights were compared with the 50th percentile of NCHS reference standards for age and the children were categorized into different grades of under nutrition based on the 'Z' scores (Rao and Vijayaraghavan, 1996). The children were examined for the deficiencies of iron, vitamin A and B-complex vitamins with physician's help. Hemoglobin (Hb) status of the children was assessed by cyanmethemoglobin method to categorize them into different grades of anemia (Demaeyer et al. 1989).

Baseline information revealed that the selected families belonged to low socio economic levels with agriculture as the main occupation. Nutritional assessment indicated (Table 1) the prevalence of underweight (45%), stunting and wasting (20%), moderate (73%) and severe (23%) degrees of anemia, Bitot spots (8%) and angular stomatitis (13%). The diets of the children were cereal based, low in protective foods with inadequate macro and micronutrients. The extent of inadequacy was found to be higher for micronutrients. Hence interventions were designed to correct the inadequacies and to improve the micronutrient status.

Intervention Programmes

Interventions were given in the form of synthetic nutrients for one group and a food supplement (biscuits) to another group against a control group with no supplements. Biscuits were formulated with the help of experts at Central Food Technological Research Laboratory, Mysore for optimum levels of iron, vitamin A and calcium (Table 2). The biscuit and nutrient groups were further subdivided into two each wherein one of the groups was treated for helminthes (150mg Mebendazole given in three doses). Keeping in view, the rural expenditure pattern the food expenditure/month/per consumption unit was taken as the index for economic status. Based on this the children were divided into five groups with the help of a statistician. There were no significant differences in the economic status between the groups ($P>0.05$). General medicines were given for minor ailments for all the groups including the control group. For ethical reasons and to build up a good rapport a lady doctor's service was provided to all the groups once a month. Though it may have reduced the incidence of morbidity during the follow-up period, it was considered essential to ensure cooperation of subjects. The interventions were dispensed for a period of 6 months under supervision. The intervention pattern, sample size, and frequency of the interventions are given below.

Categorization of children into different groups for intervention



The impact of interventions was evaluated once on completion of intervention and again after 6 months of withdrawal of interventions using the pre-tested indicators. Frequency distributions were used to obtain descriptive statistics for calculating the percentage prevalence of degrees of under nutrition. Pearson Chi-square was used to observe the impact of interventions on the nutritional status of the children.

Results and Discussion

On completion of intervention (Fig. 1) a 3 - 4% increase in the proportion of children with normal weight/age was observed in the non-dewormed food and synthetic nutrient supplemented groups, while control group showed no change. A reduction in the proportion of underweight (≤3 SD) though insignificant was observed in all intervention groups. This is in agreement with the observations of several other intervention studies where biscuits and iron supplements were given (Kruger et al. 1996, Stuijvenberg et al. 1997). Among the food supplemented groups the parasite treated group showed a better performance ($X^2 = 3.21^{ns}$) than its untreated counterpart but no such differences existed among the nutrient groups ($X^2 = 1.75^{ns}$).

Evaluation after 6 months of withdrawal of interventions revealed stability in the proportion of children with normal weight/age in three of the intervention groups against a 5% reduction in the control group. But the reduction in the underweight (≤3SD) witnessed during intervention showed a reversion to a certain extent in all groups except one (biscuit + D) group. Though it is evident that the impact of interventions on the weight gain of the children was marginal, the stability in the proportion of normal children in three of the intervention groups and a reversion in the severe degree of underweight after the withdrawal of the interventions shows its positive impact. On completion of intervention an increase in the proportion of children with normal height/age was registered (Fig. 2) in both the intervention and control groups, but the extent of improvement was comparatively better in the parasite treated groups. A reduction in the

prevalence of severe stunting (≤3SD) was observed in the intervention groups as against an increase in the control group. Thus it can be said that a hematinic brings about an improvement in the linear growth and antihelminthic therapy known to improve the absorption and retention of the nutrients in the body will help in maintaining the nutritional status. This is in line with the observations of several other workers (Kruger et al. 1996, Stuijvenberg et al. 1997) who have demonstrated that iron fortification combined with antihelminthic therapy had positive effect on the height/ age of the children with low baseline iron stores.

Reassessment of heights after six months of withdrawal of interventions revealed a decline in the proportion of children with normal height/age in all the groups (except biscuit - D) but none of them reached their pre-intervention state. Another interesting observation was the further decline in the prevalence of severe stunting (≤3Sd) even after the withdrawal of the interventions. The prevalence was lower than their pre-intervention values in all intervention groups but was comparatively higher in the control group. By the completion of intervention period the proportion of children with normal weight/height ratio increased only in the parasite treated nutrient group while all other groups showed a 3-16% reduction as shown in Fig. 3. The prevalence of wasting (≤2SD) reduced in the non-dewormed groups of both the categories as against an increase in the control group but the changes witnessed were not to a significant extent in any of the groups. A decline in the proportion of with normal weight/height ratio among the 3 intervention groups and an increase in the control group six months after the withdrawal of the interventions was observed.

It is observed that an improvement in the anthropometric indices was not dramatic, since the interventions were not calorie/protein based (to a level to bridge the deficit). The maintenance of the status in the parasite treated biscuit group suggests that if the supplementation period and quantity are increased definite improvement can be expected.

The clinical examination of the children at the completion of the intervention period showed an upward shift in the percentage of normal children in all intervention groups as against a downward shift in the control group (Table 3). The manifestation of protein energy malnutrition (PEM) showed a 2-5% reduction in one of the nutrient and biscuit groups but remained unchanged in other biscuit group. The manifestations of IDA showed a 21-56% reduction in all intervention groups except the control group. The presence of flat nails, an index of severity of iron deficiency showed a higher decline in dewormed than their non-dewormed counterparts, while the control group evidenced a 17% increase during the same period. The occurrence of Bitot spots completely disappeared in the nutrient groups, remained stable in the biscuit group but showed a smaller increase in the control group. This shows that though the vitamin A content of the biscuits was not adequate to correct the condition it had helped in maintaining the prevailing levels in the body by not overting to VAD as that of the control group. Chi-square analysis revealed that the reduction in the nutritional deficiency signs in both the nutrient and the dewormed biscuit groups were statistically significant, the extent of significance was comparatively higher in the dewormed groups ($P<0.001$) than their non-dewormed counterpart ($P<0.05$).

Six months after the withdrawal of interventions a decline in the proportion of normal children was observed in all the groups in comparison to the intervention period. The extent of reduction ranged from 8 to 29% in the intervention and 40% in the control groups. The parasite treated nutrient group and the biscuit groups though showed deterioration on withdrawal of interventions, did not overt to their pre-intervention status. The manifestations of IDA increased in

the non-dewormed nutrient and the control groups in relation to their intervention state. Bitot spots reoccurred in half of the children in whom it had completely disappeared during intervention period in the nutrient groups suggesting that though the level of vitamin A was sufficient to correct the problem, a higher quantity was required for prevention in the long run as their dietaries were very low in vitamin A. Among the biscuit groups, the occurrence of Bitot spots that was not prevalent before suggests that though the concentration of vitamin A was less in them, it helped them in maintaining the sub clinical state by not overting to VAD and needed continuous/longer periods of supplementation for prevention of VAD.

Prevalence of anemia based on the Hb levels (assessed among 80-90% of the children) at the completion of the intervention period revealed a reduction of 18-46% in the intervention groups as against deterioration in the control group (Fig. 4). The differences in the prevalence rates between the groups were found to be extremely significant (X^2=45.20***). Among the biscuit groups the dewormed group showed a reduction by 25% and the non-dewormed group by 20%. The decrease in the prevalence of severe anemia was higher in the dewormed group than non-dewormed group. This is similar to the observations of Stuijvenberg et al. (1997) who reported a 50% reduction in iron deficiency when the children were intervened with iron fortified biscuits and Gopaldas (1996) who showed that antihelminthic treatment prior to iron supplementation produced a much greater response in Hb levels. In the nutrient groups, the prevalence of anemia declined by 18 and 46 % in the dewormed and non-dewormed groups respectively. A reduction in the severe form was very clear in both the groups of which non-dewormed group showed a better performance. One of the reasons for such a difference is the higher prevalence of anemia initially in the dewormed group (Table 1).

Impact of the interventions on the Hb levels analyzed by the chi-square analysis revealed that the improvement in relation to their own pre-intervention status was significant in the nutrient groups, dewormed ($P < 0.001$) and non-dewormed biscuit groups ($P < 0.05$). The control group though showed deterioration in the Hb levels, the differences were not found to be statistically significant ($P > 0.05$). Reassessment of hemoglobin status at the end of follow up (i.e. 6 months after the withdrawal of interventions) for 25 - 40% children in comparison to their own intervention and pre-intervention values revealed (Table 4) that all the intervention groups showed a reversion. The extent of reversion ranged from 19-37% in the biscuit groups and 29-43% in the nutrient groups in relation to their intervention period. The extent of severity was increased in the parasite treated groups of both the categories than their nontreated counterparts. Though interventions brought about a significant reduction in the prevalence of anemia in all the supplemented groups, the reversion that occurred on its withdrawal was significant only in the nutrient groups indicating the long lasting impact of the food supplements.

Conclusion

Thus from the above observations it can be said that micronutrient intervention either in the form of food or nutrients will definitely help in elevating their levels in serum and in overcoming the deficiencies. Since the extent and severity of deficiencies were high accompanied by dietary inadequacies the interventions were not sufficient for sustainable improvement, which was reflected in the evaluation done after 6 months of withdrawal of interventions. Evaluation of a programme immediately after the intervention may not give a true picture of its impact on nutritional status, only a follow up over a period of time and reevaluation clearly shows the impact and potency of the intervening substances and also the suitable corrective measures.

TABLE 1. BASELINE INFORMATION OF THE SELECTED VILLAGES

Nutritional status	**% of children**
Underweight (< - 2 SD)	45.4
Stunting (≤2 SD)	21.0
Wasting (≤2 SD)	20.0
Clinical Manifestations	**% of children**
Iron deficiency anemia (IDA)	62-85
Vitamin A Deficiency (Bitot spot)	5-11
Riboflavin deficiency (angular stomatitis)	6-24
IDA (hemoglobin levels)	Moderate – 50-80
	Severe – 17-50
Nutrient consumption in different seasons (pooled)	**% Adequacy**
Calories	45-55
Protein	66-77
Iron	22-29
Calcium	32-44
Vitamin A	17-21

TABLE 2. THE COMPOSITION OF FORTIFIED BISCUITS

Ingredient	**Quantity (g/100g)**
Maida flour	48.0
Soya flour	7.2
Sugar	19.3
Fat (marvo)	9.9
Skimmed milk powder	1.0
Sodium chloride	0.5
Sodium bicarbonate	0.2
Ammonium bicarbonate	0.7
Liquid glucose	1.0
Water	9.7
Vanilla essence	2.4
Ferrous sulphate	5.3 mg
Vitamin-A acetate	0.6 mg
Calcium lactate.	107 mg

TABLE 3. IMPACT OF INTERVENTIONS ON PREVALENCE OF NUTRITIONAL DEFICIENCIES AT DIFFERENT TIME INTERVALS (% OF CHILDREN)

Group	Period	Normal	PEM	IDA	VAD	BCD
Biscuit +D	B	31	3	69	-	6
	A	77	3	20	-	3
	A6M	37	3	60	6	3
Biscuit -D	B	18	12	74	6	24
	A	47	12	53	6	6
	A6M	38	12	62	6	9
Nutrient +D	B	10	12	85	10	5
	A	63	7	29	-	20
	A6M	34	7	54	7	12
Nutrient -D	B	30	9	66	11	14
	A	55	7	41	-	11
	A6M	23	9	73	9	13
Control	B	33	21	62	5	18
	A	18	21	79	8	26
	A6M	10	18	72	8	23

+ D - Priorly dewormed, - D - non dewormed.
B - Before intervention, A - After intervention, A6M - 6 months after

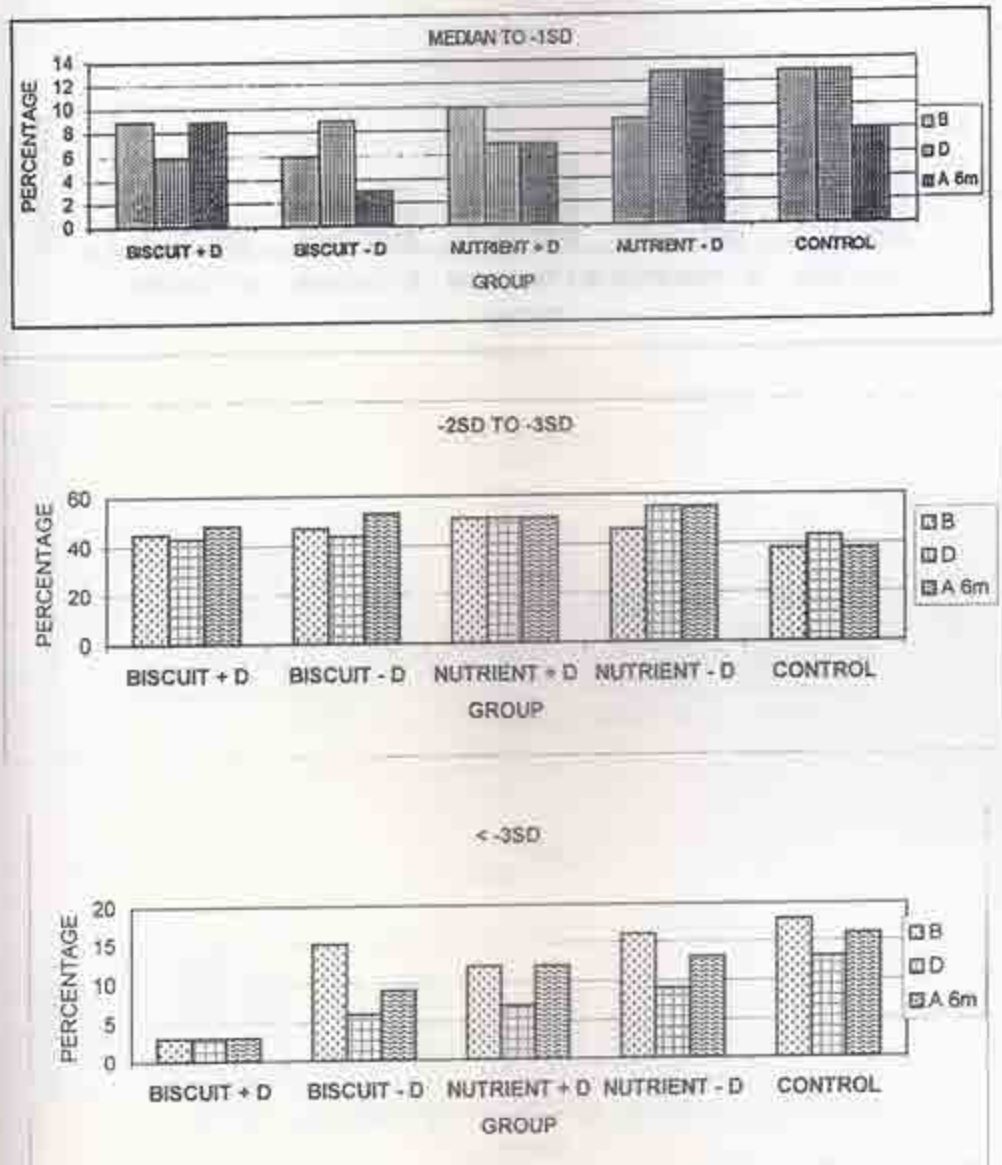
TABLE 4. IMPACT OF INTERVENTIONS ON PREVALENCE OF ANEMIA AT DIFFERENT TIME INTERVALS (% OF CHILDREN)

Group	Period	Degrees of anemia			
		Normal	Mild	Moderate	Severe
Biscuit +D	B	-	-	88	12
	A	38	19	43	-
	A6M	19	13	62	6
X^2 -- B vs A = 13.33* A vs A6M = 2.73^{ns} B vs A6M = 6.00^{ns}					
Biscuit -D	B	9	-	73	18
	A	55	9	36	-
	A6M	18	9	73	-
X^2 -- B vs A = 7.9* A vs A6M = 3.33^{ns} B vs A6M = 4.00^{ns}					
Nutrient +D	B	-	-	57	43
	A	29	21	50	-
	A6M	-	-	79	21
X^2 -- B vs A = 13.07* A vs A6M = 10.89* B vs A6M = 1.470^{s}					
Nutrient -D	B	-	-	93	7
	A	50	-	50	-
	A6M	-	-	79	14
X^2 -- B vs A = 9.8* A vs A6M = 7.39* B vs A6M = 1.50^{ns}					
Control	B	-	-	54	46
	A	-	-	85	15
	A6M	-	-	85	15
X^2 -- B vs A = 4.89^{ns} A vs A6M = 0.00 B vs A6M = 4.89^{ns}					

ns - not significant, * - $P < 0.05$

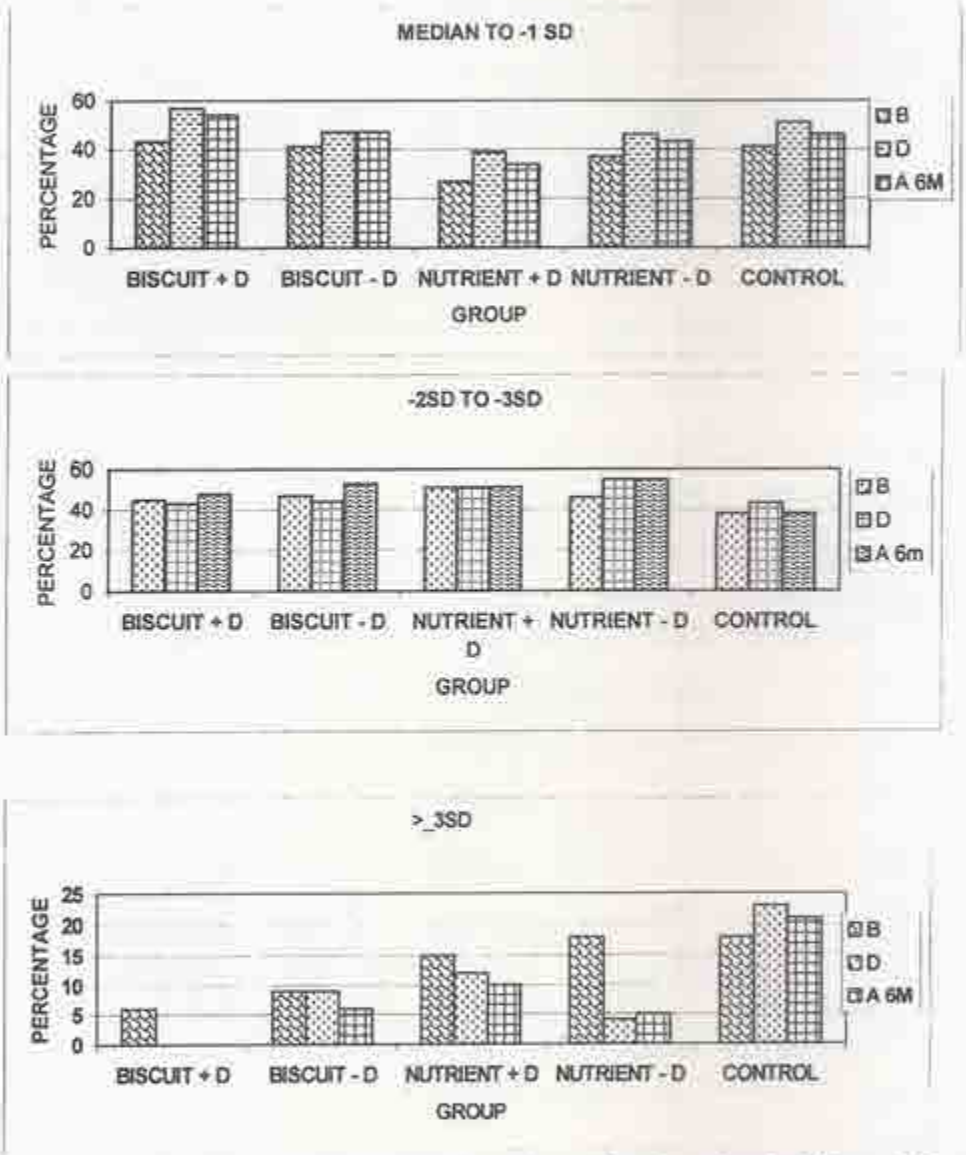
B - Before intervention, A - After intervention, A6M - 6 months after withdrawal of Interventions.

Fig. 1.ImpactOfInterventionsOnThePrevalence Of Underweight At Different Time Intervals



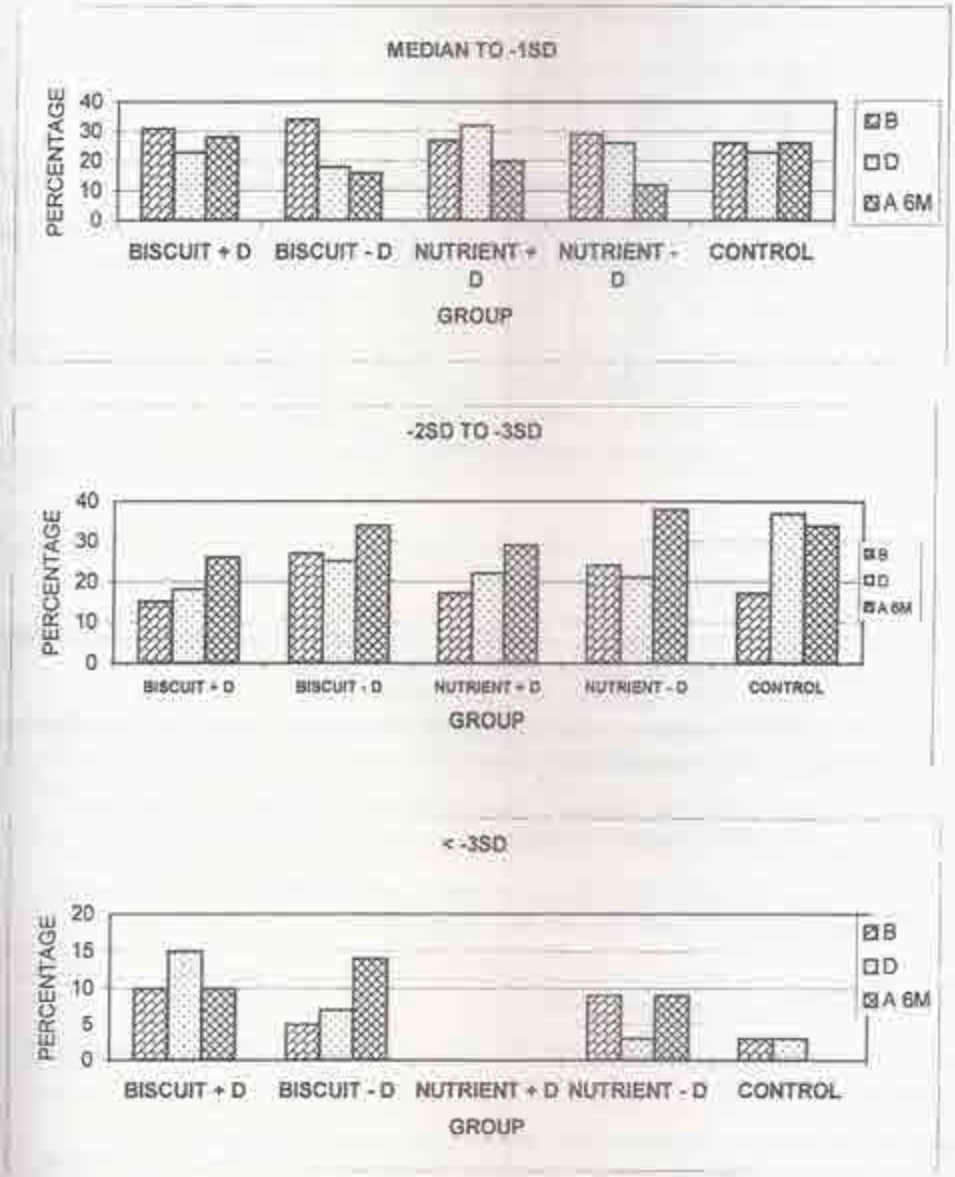
B – Before intervention, D –During intervention, A6m –After 6 months of withdrawal of intervention

Fig. 2. Impact Of Interventions On The Prevalence Of Stunting At Different Time Intervals



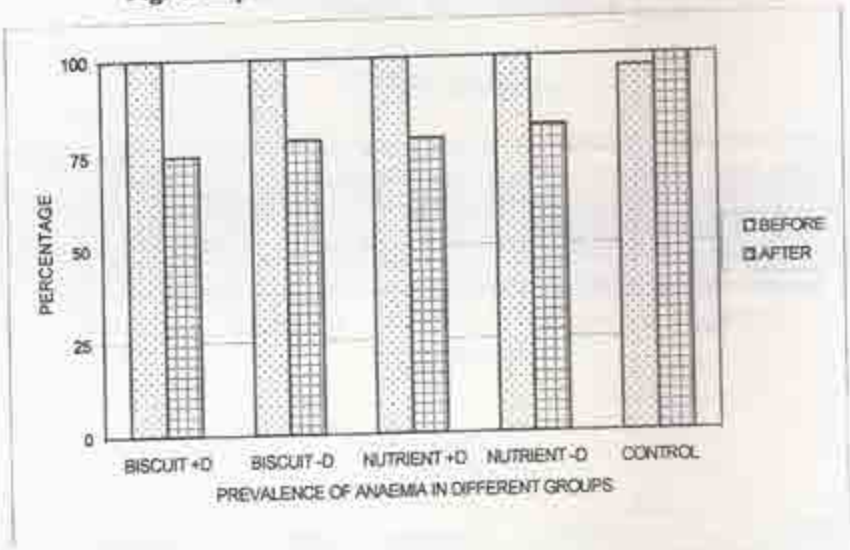
B- Before intervention, A- After intervention, A6m – After 6 months of withdrawal of intervention

Fig. 3. Impact Of Interventions On The Prevalence Of Wasting At Different Time Intervals



B – Before intervention, A – After intervention, A6m – After 6 months of withdrawal of intervention

Fig. 4. Impact Of Interventions On Hemoglobin Status



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POSSIBLE TOXIC METAL RESIDUE AND PRESENCE OF HELMINTHES OVA. IN GREEN LEAFY VEGETABLES GROWN ON RAILWAY TRACKS.

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Green leafy vegetables grown on both sides of railway track were compared with the same grown in agricultural fields for the presence of helminthes ova and toxic metal residues and their effect on other important micronutrient assimilation by the plants. Among the railway track sample 26.6% showed the presence of Helminthes ova confirming fecal contamination. Organic carbon, electrical conductivity, pH and NPK values were higher in the field soil. Toxic metals arsenic and Mercury were not detectable in the soil from either site. Except aluminum and copper other heavy metals like chromium, cadmium and lead were not detectable in the produce, although all of them were detectable in the soil at both sites. Chromium was the only heavy element, found to be higher in the field soils. Aluminum, though present in very high concentration in the soil, accumulation of the same within the plants was comparatively low. Micronutrients like Fe, Magnesium, Manganese, Zinc and Calcium concentration of most soils from railway tracks were higher whereas Sulphur and Sodium were higher in the field soil. Transmission of these elements to produce was low except for Ca, Na and S, as they were found to be high in most fields while Ca was high in railway track samples. The present study shows that with proper cleaning and cooking, green leafy vegetables grown in the sides of railway tracks are safe for consumption.

Key words: Soil contamination, Toxic metals, Helminthes ova, leafy vegetables and safety.

The transport system based on burning of liquid hydrocarbons, diesel or even on electrical energy contribute to heavy metal accumulation in soil (Saini and Gupta 2001). Indiscriminate disposal of untreated effluents from the industries near the tracks may contaminate the nearby water and the lands (Abdullah et al. 1995). All these sources may deposit heavy metals on the soil and vegetables. Regular intake of vegetables grown on such lands may increase the level of toxic metal intake above the tolerable limits. These soils may be heavily contaminated with grease and machine oils which are regularly used for the smooth running of the trains. Defecation by the slum dwellers on the sides of the tracks adds faecal matter to the soil, which is beneficial for the plant. But along with this organic matter, it may also contribute to the contamination by helminthes. The toxic metal residues along with the helminthes contamination can enter the human food chain through these green leafy vegetables. Recently, the consumers have become apprehensive about the safety of the leafy vegetables grown in these sites.

The present study therefore aims at the concentration of different heavy metals from both field soil as well as the sides of the railway tracks and their transmission to the green leafy vegetables grown on such lands and the extent of contamination of these green leafy vegetables with helminthes ova.

Materials and Methods

The green leafy vegetables were collected from the sides of the railway tracks on the central and western line in Mumbai as well from the agricultural fields of Goa and Mumbai. Vegetables that are most commonly grown on the sides of the railway tracks like spinach (*Spinach oleracea),* fenugreek *(Trigonella foenum graecum),* colocasia (*Colocasia antiquorum*), cowpea

(Vigna catjang), radish *(Rafhanus sativus)* and amaranth *(Amaranthus gangeticus* - red and green varieties) were collected along with their respective soils from the various sites up to the desired depth of approximately 35 - 36 cm. The soil collected were well mixed, dried in an oven and then used for analysis. The green leafy vegetable samples were washed in distilled water, which was centrifuged at 2500 rpm for 5 minutes. Using a Pasteur pipette a drop of the bottom layer of the solution was taken on a slide and covered with a cover slip. The slide was then observed under microscope to check the presence of helminthes ova. The moisture content of the green leafy vegetables was estimated by oven drying method. The heavy metals and micronutrients were analyzed after wet digestion of the samples. It was then cooled and the volume was made up to 50 ml with distilled water and stored in plastic containers till further analysis using Inductive Couple Plasma-AES (ICP-AES). The pH and electrical conductivity of the soil were determined in 1: 2 soil: water suspension by means of a pH meter and salt bridge respectively. Organic carbon (titrimetric method by Walkley 1935), Phosphorus (colorimetric method by Dickman and Bray 1940) and potassium (Jackson 1958) were determined for the soil samples from both the sites.

Results and Discussion

The presence of helminthes ova, an indication of fecal contamination was detected in 26.6 % of the sample collected from railway track but found to be absent in the field sample. The moisture content did not differ between the samples from both sites.

Organic carbon, pH and electrical conductivity

These three parameters of the soil affect the root cation exchange capacity of the plant thus the transmission of different elements (both toxic metal and Micronutrient). The mean pH value of railway track soils (pH 6.40) was found to be lower than that of field samples (pH 7.06). The difference in pH value of the two soil types was significant ($P < 0.05$). The organic carbon percentage of the soil from railway track (0.64%) was significantly low ($p < 0.05$) as compared to the field soil (1.64%) (Table 1). This may be due to the less amount of the total soil present on the sides of the railway track. The organic carbon % is directly related to the total nitrogen content of the soil. The electrical conductivity of the railway track samples was found to be significantly ($p < 0.05$) low as compared to the field soil. Few of the field samples (Table 1) had shown to have much higher value than the FCI limit of >3 mhos/cm. This can be explained by the various common treatments like application of salt to the soil as fertilizer. As the NPK values are the determinants of the quality of a particular soil for any agricultural activity the much higher NPK values in the field soil as compared to the railway track site indicate that soil of the latter is not good. Only radish and amaranth soil from field had a mean Phosphorus value lower than the railway track samples (Table 2).

TABLE 1. PHYSICAL CHARACTERISTICS OF THE SOIL

Parameter	Values (Mean ± S.D)	
	Railway track site	Field site
pH	6.40 ± 0.69	7.06 ± 0.41
Organic Carbon %	0.64 ± 0.38	1.64 ±1.04
Electrical Conductivity (mhos/c),	0.62 ± 0.41	9.33 ± 6.11

TABLE 2. MEAN NPK VALUES OF SOILS OF RESPECTIVE PRODUCES

Sample	N (Kg/ Ha)		P (Kg/ Ha)		K (Kg/ Ha)	
	Rail track	Field	Rail track	Field	Rail track	Field
Spinach	223.5	511.4	38.1	85.1	272.8	1120
Fenugreek	161.7	395.7	62.7	82.1	218.0	1120
Colocasia	250.1	365.8	17.9	85.1	661.0	728
Cowpea	240.1	501.1	41.8	85.1	337.7	1120
Radish	267.0	195.5	26.9	22.4	239.0	1120
Amaranth	226.3	195.5	40.3	24.6	341.8	924

Heavy metal and micronutrient concentration of the produce and their respective soil:

Soils were analyzed for seven heavy metals that are commonly present in the soil and have toxic effects on human system. Aluminum content of the soil collected from both railway track and field were found to be very high. The concentration of aluminum was found to be higher in the soil of spinach, fenugreek, colocasia and cowpea from the field site as well as in the soil of spinach, colocasia, radish, amaranth from railway track site (Tables 3 & 4). When these elements in the soil reach an optimum concentration, they get transmitted to different parts of the plant in different concentrations (Sen Ray and Chatterjee, 2003).

TABLE 3. HEAVY METAL CONTENT OF THE SOILS FROM THE FIELD & RAILWAY TRACK SITE

(mg/ 100g) on dry wt basis		Spinach	Fenugreek	Colocasia	Cow pea	Amaranth	Radish
Al	RT	1070.8	238.5	984.0	716.0	855.2	926.5
	FD	1660.5	984.0	1454.5	1305.1	632.0	716.5
As	RT	ND	ND	ND	ND	ND	ND
	FD	ND	ND	ND	ND	ND	ND
Cd	RT	0.15	0.6	0.6	0.9	ND	2.8
	FD	ND	ND	ND	ND	ND	ND
Cr	RT	2.8	ND	3.5	2.0	3.0	3.5
	FD	5.5	2.0	5.5	3.0	3.8	2.0
Cu	RT	11.4	7.5	9.0	13.5	11.5	11.8
	FD	6.5	12.0	6.0	9.0	1.7	1.5
Pb	RT	7.4	10.5	ND	5.3	ND	5.3
	FD	ND	9.5	ND	ND	ND	ND
Hg	RT	ND	ND	ND	ND	ND	ND
	FD	ND	ND	ND	ND	ND	ND

RT = Railway Track sample; FD = Field sample; ND = Not detectable

The present study showed that in general, the accumulation in the root part of the plant was higher than in shoot portion of the plant except in field spinach and fenugreek. Al was more in the shoot than in the root. Elements like arsenic and mercury were not detectable in the soil or root and shoot portion of the samples collected from both the sites. Cadmium was detected in all the railway track soil samples and also in some soils collected from the field but none of them seems to have been transmitted to any of the produce (Tables 3 & 4). Similar observations were made by

Singh and Singh (1996) and Sen Ray and Deshpande (2003) that an optimum level of elemental concentration in the soil is essential to be absorbed by the plant. Although Copper is an important component for human nutrition, higher concentration of this element in our diet may result in toxic effects. It was observed that the Cu concentration in most of the railway track soil samples were higher than the field soil except in case of field fenugreek soil (Tables 3 & 4). Cu concentrations were higher in root and shoot portion of field samples than railway track samples probably due to the use of Cu containing fertilizers and pesticides. But its concentration in the produce was well within the safe limit (>8.4 mg/day). Railway track samples had comparatively higher amount of lead but fortunately not detectable in the produce (Tables 3 & 4).

TABLE 4. HEAVY METAL CONTENT OF THE PRODUCE GROWN IN THE FIELD & RAILWAY TRACK

(mg/ 100g)		Spinach (Shoot)	Fenugreek (Shoot)	Colocasia (Shoot)	Cow pea (Shoot)	Amaranth (Shoot)	Radish (Root)
Al	RT	23.3	66.2	78.7	42.8	82.1	83.5
	FD	179.6	100.3	376.7	42.8	25.1	113.9
As	RT	ND	ND	ND	ND	ND	ND
	FD	ND	ND	ND	ND	ND	ND
Cd	RT	ND	ND	ND	ND	ND	ND
	FD	ND	ND	ND	ND	ND	ND
Cr	RT	ND	ND	ND	ND	ND	ND
	FD	ND	ND	ND	ND	ND	ND
Cu	RT	1.3	1.0	0.8	1.7	0.8	1.6
	FD	2.2	1.7	3.0	ND	0.7	0.6
Pb	RT	ND	ND	ND	ND	ND	ND
	FD	ND	ND	ND	ND	ND	ND
Hg	RT	ND	ND	ND	ND	ND	ND
	FD	ND	ND	ND	ND	ND	ND

RT = Railway Track sample; FD = Field sample; ND = Not detectable

Micronutrients:

Micronutrient analyses of the soil and the produce from both sites were done for Iron, Magnesium, Manganese, Sulfur, Calcium, Sodium and Zinc. Iron, Magnesium, Manganese and Zinc were present in higher concentrations in the soils of both sites, followed by the root and then the shoot. On the other hand, Sodium, Calcium and Sulfur concentrations of the roots and shoots of all samples from either site were higher than the soil concentrations. It may indicate that these elements are gradually transmitted to the plant (Tables 5 & 6).

Na content in the soil of field fenugreek, and radish was found to be very high and can be explained due to the general practice of adding salt in the field as fertilizer. In almost all the field soil samples and the corresponding produces, Sulfur content was higher as compared to the railway track samples. Root part of fenugreek is richer in nutrients like Fe, Mg, S, Zn etc than its shoot. Similarly Cowpea shoot is having more concentrated nutrients in terms of Mg, Mn, S, Ca, Zn etc.

TABLE 5. MICRONUTRIENT CONCENTRATIONS IN SOIL SAMPLE

		Spinach	Fenugreek	Colocasia	Cow pea	Amaranth	Radish
Fe	RT	3127.3	1601.5	3448.0	3600.0	3936.3	3696.5
	FD	2929.5▼	3077.5 ▲	4015.0 ▲	2425.0	2120.5 ▼	396.0▼
Mg	RT	1700.1	895.5	1190.5	956.3	893.8	1057.0
	FD	1524.0▼	1190.5 ▲	1351.5 ▲	1781.0 ▲	881.0 ▼	938.5▼
Mn	RT	84.6	53.5	93.5	37.5	105.5	84.5
	FD	26.5▼	101.5 ▲	116.5 ▲	68.0 ▲	20.3 ▼	19.5▼
S	RT	47.3	29.5	33.5	31.5	44.7	61.0
	FD	148.5	33.5 ▲	38.5 ▲	59.0 ▲	314.8	271.5▲
Ca	RT	1126.1	114.5	881.5	1210.0	552.7	631.8
	FD	916.5▼	1521.0 ▲	505.5	2289.0 ▲	306.3 ▼	241.0▼
Na	RT	67.3	51.5	24.0	37.5	325.2	322.8
	FD	50.7▼	71.0 ▲	366.0 ▲	90.0 ▲	229.0 ▼	2432.5▲
Zn	RT	13.8	9.0	13.5	21.8	20.6	12.3
	FD	11.5▼	14.6 ▲	16.0 ▲	15.5	3.8	12.5▲

RT = Railway Track sample; FD = Field sample; ND = Not detectable

TABLE 6. ELEMENTAL- MICRONUTRIENT CONCENTRATION IN PRODUCE SAMPLE

		Spinach	Fenugreek	Colocasia	Cow pea	Amaranth	Radish
Fe	RT	248.1	169.5	22.0	259.5	106.1	104.9
	FD	304.2▲	134.0	83.2 ▲	157.4 ▼	111.1 ▲	91.9▼
Mg	RT	112.2	350.0	209.1	210.6	89.7	800.9
	FD	166.9▲	490.9 ▲	116.9 ▲	209.8 ▼	83.0 ▼	447.8▼
Mn	RT	9.0	10.5	5.9	18.1	6.8	9.0
	FD	9.1▲	16.2 ▲	15.0 ▲	9.2 ▼	8.5 ▲	6.0▼
S	RT	473.5	17.8	126.7	410.0	465.7	220.9
	FD	210.9	398.2 ▲	210.1 ▲	127.9 ▼	366.6 ▼	679.5
Ca	RT	1545.3	149.2	417.5	4142.0	27280.3	29103.5
	FD	1723.9▲	248.9 ▲	2325.8 ▲	1885.8 ▼	698.9 ▼	9703.7▼
Na	RT	3011.8	2823.6	30.2	474.1	2125.0	1926.3
	FD	2968.3	1651.6	1430.8 ▲	3271.4	2644.4 ▲	2446.8
Zn	RT	5.4	5.5	1.8	8.0	11.7	13.0
	FD	9.4▲	7.6 ▲	2.3 ▲	10.3	5.5 ▼	12.0▼

RT = Railway Track sample; FD = Field Soil sample; ND = Not detectable

Although the concentration of almost all the elements analyzed was lower in the field soil as compared to the railway track, spinach sample grown in the field showed higher values. For fenugreek and colocasia, the elemental concentration in the soil is proportional to elemental concentration in the produce. In Cowpea, it has been observed that in spite of the field soil having

higher elemental concentration, the produce has lower than railway track sample. In Amaranth and Radish, the elemental concentration in railway track samples are higher as compared to the field samples.

Conclusions

The present study reveals that the produce grown at both sides of railway track is safe for daily consumption. It is advised though, that they are washed and processed thoroughly to prevent any external contamination.

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FEASIBILITY OF APPLYING KUTCH EMBROIDERY IN HOME FURNISHINGS THROUGH THE LOCAL ARTISANS

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Developing a product range using the popular Kutch embroidery stitches on home furnishings and studying its feasibility for production through artisans at Kutch was the main aim of the study. Though mass production was feasible at Kutch, sampling was more feasible nearby vicinity since constant monitoring is required. Sampling of goods is very essential for guiding manufacturers and consumer/retailers. Prices quoted by experts compared to consumers were more realistic. Compared to larger, slow moving, elaborate, high quality and novelty products, the smaller fast moving products could be sold at lower percent markup thus earning profits through higher sales of volume. Fashion forecast /trends in terms of fabric design and colors are important criteria's to the consumers for festive/occasional use while price is more important for regularly used goods. Brighter contrasting colors were preferred over subtle colors. Majority of the experts and consumers strongly opined that such products had a good International market. To keep up the growing demand for Indian crafts in the home market as well as export purposes, the craftsmen need to be given novel ideas.

Kutch is in the extreme west corner of Gujarat. Mochis, Kanbis, Ahirs and Rabaris represent the most important Kutch embroideries. Ahir is a pastoral tribe, who practices 'aribharat' or 'mochibharat', a community of Saurashtra. The embroidery is executed by the use of arhi, a hooked needle. The stitch therefore appears throughout as chain stitch. The traditional embroideries need to be popularized and developed into an industrial craft in order to save the reminiscent beauty of the past and everlasting art (Naik 1996). Patel (1987) reported that fabrics used for Kutch embroidery are casement, satin, poplin and khadi and the stitches used are chain stitch, herringbone, and buttonhole, darning and Sindhi taropa. Animal, bird, floral, geometric and human motifs are commonly used. Red, maroon, yellow, green, orange, brown, navy blue and magenta are colors, which are popularly used in this embroidery. Gupta (1984) in her study found that combining appliqué and embroidery and batik and embroidery were appealing, interesting and produced novel effects.

Today India produces one of the most diverse ranges of home textile products majority of which are either plain or printed. So to decorate them with colours and make it even more beautiful, embroidery is one of the options (Home Fashion India 2002). The earthquake that hit Kutch in January 2001 left the place in shatter and a good number of people are unemployed even now. To find some solution to this problem of unemployment the present study aimed at developing a product range using Kutch embroidery stitches on home furnishings and studying its feasibility for production through artisans of Kutch.

Materials and Methods

Design features were created through 3 cut and paste mood boards based on fashion forecast, each one pertaining to bedroom, living room and dining room. 7 shapes of articles and 7 different layouts of design were created using Computer aided designing for 12 different types of articles namely cushion covers, bed sheets, sofa backs, dining mats etc. Scattered designs, subtle

colors and novel motifs were kept in mind while designing to give the products a new look. Four embroidery stitches of Kutch viz. chain, herringbone, darning and mirror work were used to create samples of 15 motifs. 100 respondents (50% experts including whole salers, retailers, textile designers, interior decorators and soft furnishing designers, and the other 50% consumers including working men and women, housewives and students) were surveyed for selection of best motif, best layout and best shape based on which 1 set of 12 articles (15 pieces) in cotton were produced in Mumbai and 2 sets one in cotton and one in satin (47 pieces based on orders procured) were produced in Kutch. They were compared in terms of embroidery, finishing, cost and lead-time. Experts in the industry helped calculating the selling price/specified price for each article. 45 respondents were selected based on convenient sampling, which included 15 experts and 30 consumers and were interviewed to see the cost effectiveness of articles and willingness to buy the articles at the specified price.

Results and Discussion

Motifs, Shapes Layouts

Analysis of preliminary survey carried for the preference of motifs, shapes and layouts revealed that motif C, M and N were the most preferred by consumers and experts. 86% respondents were willing to buy Kutch embroidered home furnishing, indicating that there is market for them.

Pricing

There was difference in the price quoted by experts and consumers for each article before (only seeing pictures) and after sampling (seeing products) (Table 1). The consumers quoted a very low price of purchase compared to that quoted by experts. The actual cost of production as well as the specified /selling price, which included the mark up, calculated after the production of the articles was within the range of the minimum or maximum price range quoted by experts before sampling for majority of the articles except napkin which costed more than the quoted price. The selling price or specified price calculated, for the articles such as sofa back, tea cozy, table mat, table cloth, lampshade and wall hanging were within and more towards the maximum range of price quoted by consumers before sampling (i.e. only seeing pictures). However the selling /specified price of all other articles such as bed sheet, pillow cover, cushion cover, tea coaster, curtain and napkin were above the maximum price range quoted by the majority of the consumers. Even the actual cost of production of some of the articles such as bed sheet, pillow cover, curtain and napkin were not within the quoted price by consumers. Before seeing the products and based on paper designs and embroidered samples of motifs, the quoted price by experts was thus more realistic to the actual production cost compared to consumers who quoted very low price. The consumers are ignorant of cost elements and probably cannot foresee the price before seeing the actual product. After seeing the products many of the respondents were ready to buy most of the products at the specified price. Few experts and consumers who were in disagreement with the selling / specified price found these products highly priced and quoted new prices (Table 1). The lowest selling priced item (tea coaster) was the highest opted article by consumer for purchase. While the highest rated selling price item scored the lowest rating for purchase (bed sheet). However experts suggested that the products, which are, used daily such as the napkins and bed sheets, can be lower in price, where as one-time investment products such as lampshade and curtain could be expensive. According to experts the fast moving articles in the market can have

low percent mark up, and the slower moving articles can have a higher percent mark up. Thus one can earn the profit in both the cases, but in the former it is through the sales of volume, and in the latter it is through the higher percent mark-up. There was a wide difference in the quoted price of articles by expert respondents before and after seeing the finished articles. In case of all the articles (except napkin) the price quoted after seeing the products was very low compared to that quoted after seeing only pictures. The experts felt that a higher price could be quoted if the fabric, embellishment, accessories, linings are of excellent quality and are novel.

Although sampling is an expensive process, it is an important step in the process of product development and commercial production. This was very clearly seen in the results obtained before and after seeing the finished products. Consumers get the right concept of product only after seeing it. Print outs and the photographs alone are insufficient for procuring orders as well as in fulfilling consumer demands and satisfaction. Samples produced can work in the interest of the manufacturer since it guides during commercial/mass production.

Products

Majority of all the articles were rated as good or average, however lampshade was rated unanimously 'good' article by consumers and experts (Figs. 1 & 2). Experts opined that fabric forms the base, which is related to aspects like design, comfort, and finish. Fashion and cost are also related to the fabric, as in which fabric is currently running in the market and the cost of the particular fabric. Different fabrics such as jute, denim, raw silk, khadi, could be used for developing new product range. Satin fabric was more acceptable and preferred due to the shine and overall effect. From consumers point of view fashion trends form an integral part for selection of home furnishing for festive or occasional use while cost and fabric are more important for selection of home furnishing, for the regularly used articles. The consumers want a reasonably good quality fabric but at reasonable cost as these articles need to be bought quite often. From the consumer survey it was also found that the articles produced for the dining room were more preferred compared to those of the living / bed room except lampshade and wall hanging.

Majority of the respondents including experts and consumers liked the products for the embroidery, design, finishing, colour combinations and shapes. Few gave suggestions for more brighter and contrasting colours. Brighter colour combinations of the articles were preferred than the subtler. The style and pattern of products varied therefore finishing rates varied. Personal contacts helped in procuring orders. Customers did not prefer to buy the entire range but selected few pieces and gave their own colour specifications to suit their homes. Orders with different specifications were experimented to compare rate for different product finishing and different designs i.e. butti and border. Execution of orders with different specifications did help comparing cost of embroidery, embroidery quality and feasibility of production.

The style and pattern of products as well as the finishing rates varied. Personal contacts helped in procuring orders. Customers did not prefer to buy the entire range but selected few pieces and gave their own colour specifications to suit their homes. Orders with different specifications were experimented to compare rate for different product finishing and different designs i.e. butti and border. Execution of orders with different specifications did help comparing cost of embroidery, embroidery quality and feasibility of production.

TABLE 1: PRICING OF VARIOUS HOME FURNISHING ARTICLES BY EXPERTS AND CONSUMERS BEFORE AND AFTER SAMPLING.

Article	Survey 1		Cost incurred	Specified /Selling price	Agreement	Survey 2 Non-agreement to specified price	
	Rs	Rs	Rs	Rs	% Respondents	Rs	Rs
	Ex	Co				Ex	Co
Bed sheet (Double)	700-1000	300-750	808	1000	20	600-800	500-900
Pillow cover (2pcs)	101-500	35-200	212	275	27	150-250	100-250
Curtain	301-800	75-550	581	625	27	400-550	400-550
Sofa back (1 pc)	151-500	35-200	125	155	53	100-125	100-150
Cushion cover	150-300	20-130	125	155	44	100-125	75-125
Tea cozy (1 pc)	51-200	15-200	126	155	40	100-125	100-140
Tea coaster (1 pc)	25-41	4-27	21	30	56	15-25	15-25
Table mat (1 pc)	100-400	15-120	83	100	56	50-80	40-85
Table cloth (1 pc)	100-300	50-250	169	215	47	150-200	99-175
Napkin (1 pc)	25-50	5-41	68	80	60	40-55	40-70
Lampshade (1 pc)	300-700	60-300	278	300	78	200	100-250
Wall hanging (1 pc)	200-750	50-370	111	200	53	100-150	100-150

* Selling / specified price includes actual cost + mark up
Ex-Expert
Co-Consumer

Costing

The cost of embroidery done from Kutch was marginally low as compared to that executed in Mumbai, even after considering raw material, transport, and communication/ coordination costs.

Embroidery:

Quality/ Finishing of embroidery of both the regions confirmed to samples produced. In fact artisans in Kutch had made the chain stitch and abhala even better than samples provided to them. The cost of embroidery in Mumbai was 5 Rs/motif, with or without mirror, where as the Kutch embroidery the rates were different, which was Rs 4/motif without mirror, Rs 4.50/motif with mirror and Rs 4/inch of the border.

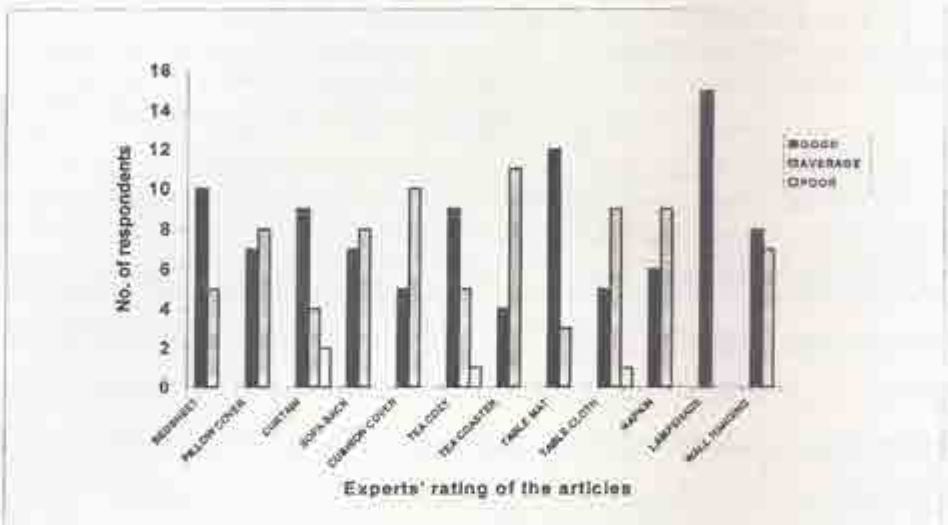

Fig. 1. Experts Opinion Rating For The Articles

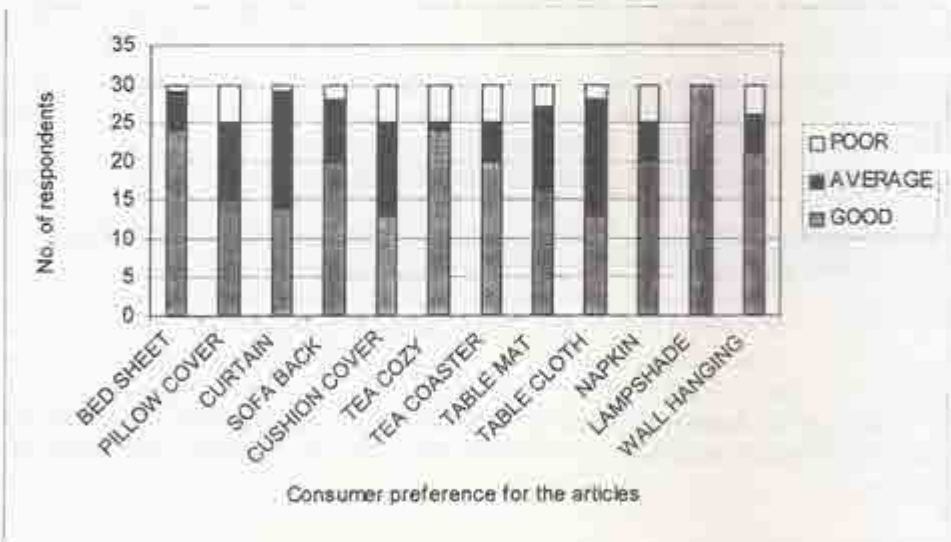

Fig. 2. Consumer Opinion Rating for The Articles

The rates were more in Mumbai as compared to Kutch Time taken to complete the embroidery in Mumbai was 20 days for 15 pieces, where as it took 25 days to get the articles (47 pieces) embroidered from Kutch, including the 4 days of transportation. Sampling in Mumbai was found to be effective indicating that it should be within close proximity as constant monitoring for confirmations and decisions for changes are required. But for commercial mass production the

artisans in Kutch would surely prove to be better as far as art/skill availability and efficiency is concerned as well as to meet consignments/target dates. Readiness of Kutch artisans and transport facility were found to be feasible inspite of distances.

Market survey

Most of the experts (93%) and consumers (83%) agreed that these products would be acceptable in the Indian market, indicating that the market is ready to try out new designs. 93% of the experts and 87% of the consumers agreed to the acceptance of these products in the International market, but they felt that the price could be lowered through giving simpler but neat finish, sourcing good quality yet less expensive fabric and accessories, mass production, sourcing cheaper finishing units / tailors. Majority of the respondents felt that the Indian and International markets would be open to such kind of work and if the articles are produced commercially, they would do well in both the markets. All the respondents (100%) gave a positive response as to the study being a step toward promoting the art and craft of Kutch.

Conclusions

Mass production would be more feasible at Kutch thus providing employment. However sampling would be more feasible in close proximity for better supervision and decision-making. Consumers prefer smaller products, as they are inexpensive. Fashion trends in terms of fabric design and colours are important criteria's for home furnishing for the consumers for festive / occasional use while price is very important regularly used goods.
Brighter contrasting colours were preferred over subtle colours. To keep up the growing demand for Indian crafts in the home market as well as export purposes, the craftsmen need to be given novel ideas, which they can translate into the much appreciated traditional crafts.

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CURRENT TRENDS IN COLOUR TELEVISION.

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Global scenario has been changing constantly depending on the technological development and the consumer demand. Color Television market shows a high growth rate of flat CTVs, Price reductions and LCD technology Digital CTVs in the near future.

While the impact of mass media especially television on the behavioral characteristics as well the reading ad writing habits of children is being discussed at length today, there is a phenomenal growth in the technological development and the demand for the latest version of Color televisions (CTV) in our country. In fact our country has come a long way from having only one small Color televisions for the whole Panchayat or joint family to a state of 17 CTV in every 100 households. Thus the industry is growing at a rapid pace and CTVs have become an indispensable source of entertainment for us today, which were looked upon as a luxury item affordable only by the rich.

There are different types of CTVs available in the market today. Broadly dividing into three kinds – conventional, flat and projection type use five main types of technologies. They are: 1. Cathode Ray Tube technology (used in conventional CTVs), 2. Liquid Crystal Display (LCD) technology (used in flat and projection CTVs), 3. Plasma Display Panel (PDP) technology (used in flat CTVs), 4. Digital Light Processing and 5. Liquid Crystal on Silicon (used in projection CTVs). Currently, the most popular technologies are the LCD and PDP technologies used in flat screen CTVs that make them thinner and lighter.

After the Government allowed the import of CTV components for assembly in 1982, the demand for CTVs has been rising steadily. Since then, many manufacturers have set up manufacturing units in the country due to the comparatively low capital costs involved in CTV manufacturing and the sharp growth in demand. The spurt in demand over the years was due to decrease in prices, increase in the disposable incomes of the people and the existing low penetration levels of CTVs in India.

The demand for CTVs in 2002-03 was around 7.3 million units. This was a 35 % growth over that of the previous year. The Indian CTV market is predominantly a conventional CTV market. Flat CTVs are just catching up the market space. Among the sub-segments, the 20", 21", 14" and 29" CTVs are most popular in that order. Flat CTVs currently account for only 3 % of the total CTV sales. This share of sales is expected to surge to 9-10 % by 2007. This is mainly due to the reducing price difference between flat and conventional CTVs. The pricing of CTVs is directly related to costs of the components (especially CPTs). It is the manufacturing cost and the component cost that govern the selling price. Raw materials account for 80 % of the total cost of manufacturing CTVs. Among raw materials, the colour picture tube (CPT) accounts for 47 % of the costs. Hence the total cost of an item in the market depends on the fluctuations in the cost of CPT, which have been falling due the large number of manufacturing units set up in the country. Costs involved in importing thus get minimized. Another reason for the fall in prices is the intense competition in the industry.

Until the early 1990's, there were only domestic players in the market (BPL, Onida and Videocon). Then came the Japanese major Sony and the Dutch major Philips followed by the Korean companies LG and Samsung, followed by the European company Loewe, Japanese Matsushita and Sharp and the Chinese companies TCL and Konka. The domestic CTV industry currently has around 25 brands. The main players in the market are LG, Samsung, Mirc (owner of the Onida brand), Videocon, Philips, BPL and Sony.

Currently the Korean players have taken over the top positions completely in the conventional and flat segments. In the conventional segment, BPL was the market leader until 2002 when LG and Samsung took over the first and second positions respectively. BPL is now in the sixth slot largely due to its financial constraints (the company is in debt of around Rs 1200 crores) due to which it is unable to spend on advertising and marketing which is very important for any industry. Mirc has maintained its market position steady now being the third largest player. Philips and Videocon have dropped their market shares due to the increasing competition in the industry. In the flat segment, Samsung has taken over the leadership position from Sony in March 2003. It is to be noted that Sony focuses only on the flat CTV segment. LG is at third position and is also threatening Sony's current position at the second slot.

The Korean players were not successful in their first attempts to enter the Indian CTV market. For instance, LG had to enter a third time for it to establish a strong foothold in the industry. Korean CTVs are perceived by the people to have a good quality though they are slightly higher priced than their Indian counterparts. Also the marketing strategies of the Korean players have been very aggressive as compared to those of their competitors. Moreover, they have been able to establish a very strong distribution network within a few years of their entry into the market, which enables them to reach consumers in every part of the country. Added to this is the superior technology, which they import from their parent Korean companies. LG and Samsung are expected to continue to rule the market for the years to come due to their ability to launch new products at frequent intervals, aggressive marketing strategies, high quality perception among the consumers and their extensive distribution network. BPL is expected to continue its decline in the medium term. However it may pick up market share in the long run after the turnaround, which it is planning by borrowing from a European firm. Philips is expected to gain market share due to its focus on new technology and its ability to launch products in a timely manner. Mirc (Onida) would maintain its position in the long term too owing to its increased focus on the emerging medium and premium segments (large-screen flat CTV segments). Videocon is expected to fall further in sales revenue terms due to its focus on the low-value mass-end segments (14", 20", 21" conventional segments), which may bring in sales volumes but comparatively lesser revenue. Sony will continue to face tough competition from the Korean majors. But the company has no plans to market its products aggressively or enter the mass-end segments for a short-term increase in its market share. It plans to focus only on the top-end flat segments, which has a growing market in the country. Hence its market share is expected to rise in the long term.

At the global level, CTV market is 152 million units strong. China and USA are the major markets while Philips, Samsung, LG, Sharp, Sony, Matsushita, Sansui and Toshiba (in random order) are the top players. Most Governments worldwide are making it mandatory for broadcasting to be in the digital mode. Hence all CTV sets will have to be made digital-enabled in a few years to support the digital transmission of signals.

Thus the trends observed in the worldwide CTV market show a high growth rate of flat CTVs, Price reductions and LCD technology Digital CTVs in the near future.

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EMPOWERMENT OF WOMEN IN URBAN FAMILIES.

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The present study was done on 75 working women and 75 non-working women from twin cities of Hyderabad and Secunderabad. Both the groups were combined to see the influence of different independent variables on their empowerment status. In-depth interview method was adopted to collect reliable data from the sample. Standardised empowerment scale was used to study the empowerment levels of women. F ratios were calculated to check the significant differences among the groups of women. The study revealed that Women perceived higher level of power when their spouses had higher educational level, higher occupational level and higher income level. Women with higher duration of married life had a higher level of empowerment. Women with higher natal family support, in-law family support and spousal support had more power in the family those with more favorable intrinsic personality traits for themselves as well as for their spouses had more power in the family.

THE PLAYWAY APPROACH FOR NUTRITION EDUCATION

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An attempt was made to develop a teaching strategy through educational games on the subject of food and nutrition and to evaluate their impact on learning. A sample of 120 students from 8th standard from a school was divided into three groups. Five educational games namely, 'Snake and ladders', 'Bucket game', 'Who am I', 'Housie' and 'Card Game' (on different topics of food and nutrition) were developed. The first group was exposed to the content with help of lecture method only. The second group was taught by lecture method while they remained passive viewers (observation) of the educational games. The third group was exposed to the content with the help of lecture method and they actively participated in educational games also. Knowledge of the students was tested by the questionnaire method before and after the interventions. The results indicated that the strategy was effective in teaching the selected content. The students who learnt through lecture method along with participation in the games scored the highest. There was no difference between the scores obtained by male and female students.

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DIFFERENTIAL TEACHING STRATEGIES USED BY EARLY CHILDHOOD TEACHERS OF HARYANA AND CHANDIGARH (U.T.)

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The study was conducted in 58 pre-primary schools, 29 each from Hissar and Chandigarh. Schools were selected from rural, urban and peri urban areas including pre-school laboratories in both places. Interview method along with observation was employed in collecting the data from the Principal and the teachers about the teaching strategies. It was found that most schools had play-way method of teaching in their curriculum but not in practice due to lack of desired equipment and facilities. Pre-school laboratories used flexible schedule from silent to vigorous activities but other schools were unaware of its importance and followed strict timetable schedule making children uncomfortable and disinterested in school activities.

About 72% schools provided opportunities for story telling sessions at both palces. Some of the schools from both places seasonally arranged field trips, visits to zoo, gardens or museaus and self-help activities. Use of puzzles and group discussion for problem solving activities was observed in 45% and 59% in Chandigarh and 21% and 31% in Hissar respectively. Use of audio and videocassettes was about 41% and 15% respectively in both the places. However, use of computers was more in Hissar (21%) than Chandigarh (10%).

Children with special needs was also considered more in Chandigarh but few schools could give them special care by retaining them after educate or referring them to specialists. Parents were also made to participate in school activities mainly with cultural programs.

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