Research Reach

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Research Centre,
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RESEARCH REACH
JOURNAL OF HOME SCIENCE

EDITORIAL

Over the years, Home Science has diversified into several areas of specialization such as Food Science, Nutrition, Dietetics, Human Development, Textiles, Fashion Technology, Family Resource Management etc. Research on recent topics in all these domains, besides being of academic interest, has tremendous implications for society and the industry at large. Research Reach – Journal of Home Science, published bi-annually by the Research Centre at Nirmala Niketan, College of Home Science, is an attempt at publishing original research and review articles from all areas of Home Science. The journal not only serves as a platform for Home Scientists to share their research findings with their peers across India but it would also prevent duplication of valuable research time and expertise. To this effect, a list of the thesis titles from the post-graduate departments of one Home Science institute would be published as an additional feature in each issue of the journal. This issue, therefore summarizes the post graduate thesis topics that were covered during the academic year 2005-2006 at the college of Home Science, Nirmala Niketan, University of Mumbai.

Chief Editor
Malathi Sivaramakrishan

INSTRUCTIONS TO THE AUTHORS

Home Science Research Journal is devoted to original Research and Development in all branches of Home Science. It is a bi-annual publication from the Research Centre of College of Home Science, Nirmala Niketan, 49, New Marine Lines, Mumbai – 400020.

The format of the journal includes:

1. Review paper on specific topics of current trends pertaining to Home Science. It should be a mini review with around 12-16 typed pages.
2. Research papers with a maximum of 6-10 pages
3. Research notes limited to a maximum of 2-4 typed pages
4. Paper / Book Review of not more than 1 typed page each.

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Title page: Title of the paper, the names of authors and the name of the department should be given

Abstract: Give an abstract of about 100-150 words reporting concisely the objectives, approach and the principal findings.

Text: The text can follow the abstract in the same page with introduction, materials and methods, results, discussion, acknowledgement, if any and references.

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Example: Machado P, and Prakash J (2006) Morbidity profile and prevalence of anemia in Indian Women From a rural coastal community J. Food Sci. Technol. Nepal, Vol 2, 53-56

The data reported should be authentic and original with clear objectives, materials used, methods employed and the results obtained. It should not have been published or offered for publication elsewhere. The author should give an undertaking in writing to this effect.

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CURRENT STATUS OF VITAMIN A NUTRITURE IN PREGNANT AND LACTATING WOMEN

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World Health Organization has adopted a resolution in 2006 to prevent avoidable blindness and visual impairment, as even today more than 160 million people are visually impaired globally, 75% of blindness is preventable. Vitamin A deficiency in pregnant and lactating women has worst consequences from the point of view of future generations. Prevention of Vitamin A deficiency in pregnant women is pivotal for eradication of blindness worldwide. The magnitude of the problem in pregnant women is not known but there are very few prevention programs for this vulnerable group. Advances made in understanding the problem and the progress that has been accrued so far is discussed here.

KEY WORDS: vitamin A, maternal vitamin A levels, maternal beta-carotene levels, Vitamin A toxicity, vitamin A supplementation.

Vitamin A in embryogenesis

Today vitamin A is known to be involved in fetal development and in regulating the proliferation and differentiation of many cells throughout life (Spron et al, 1984). These roles are particularly critical during periods of proliferative growth and tissue development, as in pregnancy, infancy and early childhood. Until the 1950s, a relatively large number of studies showed that laboratory animals (pigs, rabbits, chickens, rats and mice) fed vitamin A –deficient diets gave birth to malformed offsprings, mostly affected by microphthalmia and anophthalmia associated with abnormalities of the cardiac, lung and urogenital systems (Wilson et al, 1953). Because of the lack of appropriate analytical techniques at that time, maternal vitamin A concentrations were not recorded. More recent studies in Retinoic Acid Receptor (RAR) clearly confirm the role of vitamin A in embryonic development. Interestingly, a study in rats showed that retinol is required during mid-gestation for neonatal survival. In the absence of retinol, the pups exhibit a lethal failure in lung development (Wellik et al, 1997). This seems similar to the respiratory distress syndrome observed in premature infants whose vitamin A status is often deficient. Severe vitamin A deficiency is also responsible for abnormal spermatogenesis in animals (Van Pelt, 1995).

Zoo technicians have found a positive association between β- carotene intake and fertility of cattle, but no similar relation for vitamin A intake (Akordor et al, 1986). In light of these findings, a higher incidence of malformed babies would be expected in areas of endemic vitamin A deficiency, but this is not the case. This apparent discrepancy may arise from the failure to report birth defects in these countries. The number of reported cases remains surprisingly low. The few cases reported occurred in India. Even the 15 cases of microphthalmia or anophthalmia reported over a 10-yr. period, is not considerably excessive (Kapoor & Kapoor, 1977). Retinoic acid functions as a ligand controlling a nuclear receptor-signaling pathway involved in vertebrate growth and development, reproduction and cellular differentiation. Retinoid signaling requires enzymatic conversion of the inactive ligand retinol (Vitamin A) to the active ligand retinoic acid and delivery to target cells. In response to ligand binding, nuclear retinoic acid receptors regulate gene expression directly at the transcriptional level. Although the transcriptional activity of vitamin A- signaling is well described, it is not fully understood how the embryo: a) first acquires retinol, the dietary form of vitamin A ; b) synthesizes retinoic acid (RA), the biologically active derivative, and c) controls the intracellular transport of both.

Recently Wood et al (1996) and Ward et al (1997) have described the distribution of proteins believed to be responsible for these events in developing rodent embryos as a) retinol binding protein receptor (RBPr) b) cellular retinol binding protein (CRBPI) c) retinol dehydrogenase enzymes (RoDH) and d) retinal dehydrogenase enzymes (RalDH). These proteins are found together in tissues that suffer in conditions of vitamin A deficiency; tissues that either produce RA as a signal or respond to it.

Recommended dietary allowances

The RDA during pregnancy is not different from that of nonpregnant state. A chronically inadequate intake below the basal requirement must take place to critically deplete maternal body stores before detrimental effects on the mother and fetus occur (Underwood, 1994). Estimated basal and safe intake levels for vitamin A by WHO are given in Table 1. The basal requirements are the levels, which if ingested would be adequate to prevent impaired function. Safe levels are those required to prevent impairment of function and also maintain desirable tissue stores. These requirements can be fully met through traditional food sources (Ramchandran, 1996). ICMR (1994) has recommended no additional dietary allowance for Indian pregnant women. However, the additional needs during lactation (350 µg retinol/day) are calculated on the basis of vitamin A secreted in milk (FAO/WHO, 1967). NNMB (1989) shows concern that dietary intakes of vitamin A by Indians are much below the recommended levels. Olson (1987) has commented upon recommended dietary intakes (RDI) of vitamin A in humans. In his paper a satisfactory vitamin A status is defined as a total-body pool that provides adequate vitamin A to meet all known physiological needs and a reserve for 4 months on low intakes or during stress. Vitamin A needs in infants, children, the elderly and the pregnant and lactating women are quantified. The toxicity of vitamin A in early pregnancy, for which a safe intake level is not known, is stressed. In contrast to the industrialized countries, the median intake from food for most women in many non-industrialized countries is chronically lower than the safe level of intake, frequently near the basal requirement (Protocarrero et al, 1991) and their diet usually does not change during pregnancy. They are also likely to have limited body reserves (Underwood, 1994)

TABLE 1 ESTIMATED REQUIREMENTS FOR VITAMIN A

GROUP	BASAL REQUIREMENT (µg RE/day)	SAFE INTAKE LEVEL (µg RE/ day)*
Pregnant women	370	600
Lactating women	450	850
* source: WHO/NUT, 1995		
	RETINOL (µg / day)	β-carotene (µg / day) #
Pregnant women	600	2400
Lactating women	950	3800
# source: ICMR,1994		

Repercussions of Vitamin A deficiency

Maternal vitamin A nutritional status during pregnancy must be optimal in order that adequate hepatic stores are built up in the fetus. It is regretted that very little attention is being paid towards improvement of vitamin A status of the mother during pregnancy, as part of antenatal care. Since, massive doses of synthetic vitamin A cannot be administered in pregnancy because of its teratogenic properties the question of maternal vitamin A status is largely being underplayed. The infant has to receive its vitamin A from the mother's milk. It is only through ensuring good maternal vitamin A status that the adequate vitamin concentration in breast milk can be achieved.

Clinical manifestations of VAD may not be evident in mother, but the swiftly developing fetus may be assailable to subclinical deficiency. Limited data on human placental transport of vitamin A indicate that the vitamin supply is closely regulated within a safety margin except at extremes of deficiency and excess of vitamin A intake. Wallingford and Underwood (1987) have demonstrated controlled progressive depletion studies indicating differential loss from various maternal tissues. The placenta and fetus are sensitive to maternal vitamin A status at very low dietary intakes. Ocular tissue is relatively stable and independent of changing maternal dietary vitamin A intake until other tissue levels are quite depleted. When concentration in maternal ocular tissues begins to decrease, those in the placenta and fetal tissues also decrease. Animal studies using rats point to the fact that the vitamin A requirements vary over an entire gestational period with the greatest requirement in the first half of the pregnancy, i.e., gestational days 10-13 when needs appear to be threefold higher than at day 16 onwards (Wallingford and Underwood, 1986). Severe deficiency of vitamin A causes infertility or impaired reproduction in all vertebrate species that have been studied (Bates, 1983; Hurley & Doane, 1989). The prevalence of impaired dark adaptation during pregnancy has been reported from 3-4% to more than 35 % (Dixit, 1966; Subbulakshmi, 1970). Night blindness during pregnancy could signal fetal risk and warrant special attention. On the other hand, because night blindness most frequently occurs in the third trimester of pregnancy and often spontaneously disappears after parturition (Dixit, 1966), the phenomenon may or may not be specifically related to maternal vitamin A status or to fetal vulnerability. But despite these repeated observations so long ago, no attention has been paid to this aspect. Underwood (1994) has rightly stated that studies are needed to establish the vitamin A status of pregnant women who complain of night blindness. Vitamin A status of the newborn in relation to gestational age, body weight and maternal nutritional status has also been considered (Shah and Rajalakshmi, 1984). Mothers of premature infants have lower levels of serum vitamin A than those of full-term infants suggesting maternal vitamin A status to be one of the correlates of prematurity. Significant correlations have been also found between cord serum vitamin A, maternal serum vitamin A, gestational age, and growth status. Baker et al (1975), Gorodischer (1993), suggested that a poor vitamin A status is one of the features associated with a higher prevalence of prematurity and intrauterine growth retardation in poorly nourished populations.

Prevention of neonatal vitamin A deficiency is related to the adequacy of maternal vitamin A stores. Shirali et al (1989) reported that serum vitamin A levels were significantly higher in high socioeconomic mothers without clinical evidence of vitamin A deficiency. However, a significant difference between these groups in the cord blood RBP was not observed. A logarithmic relationship was revealed between maternal and cord blood vitamin A levels suggesting saturable transplacental transport of vitamin A. Ibrahim et al (1991) have also reported high prevalence of pregnant women with mean plasma vitamin < 33 µg% and also low vitamin A status in their newborns. Women with the values > 33µg % had significantly higher intake of vitamin A and similarly the newborn babies of these mothers had significantly higher levels of vitamin A. The composition of breast milk is influenced by the vitamin A status and serum concentrations of the mother during the last trimester of pregnancy (Ortega et al, 1997). Normally the fetal liver stores show a gradual increase in vitamin A concentration until middle of the 3rd trimester, with little change thereafter. The fetal liver vitamin A concentration ranges from 10-90 µg/g at term with a wide individual variation. In populations where the mothers have marginal vitamin A nutriture, the fetal or neonatal hepatic vitamin A concentration has been found to be low. Studies in India have shown that 35-50% of such fetuses had liver vitamin A concentration < 10-90 µg/g of liver tissues (Iyengar and Apte, 1972). Moreover, poor maternal vitamin A intake reduces the amount of this vitamin excreted into breast milk in turn limiting the intake by an exclusively breastfed newborn.

Various researchers (Wallingford and Underwood, 1987; Davilla et al, 1988; Tanumihardjo et al, 1996; Ortega et al, 1997) have shown that vitamin A intake and serum vitamin A concentrations during pregnancy influence the composition of breast milk.

Vitamin A metabolism in pregnancy

Vitamin A metabolism in pregnancy is perplexing and is distinguished by a variety of complex components that maintain tissue availability of the vitamin in the face of wide variations in intake. This is an evolutionary safeguard because both inadequate vitamin A and excessive intake of retinoids (including vitamin A) are associated with fetal resorption, abortion or birth defects in both experimental animals and humans (Olson, 1994). Gardner & Ross (1993) and Posatlempo & Ross (1993) have demonstrated that the transport of vitamin A from mother to embryo and fetus is tightly modulated. There is high priority for transfer of vitamin A from mother to fetus. Vitamin A concentration in the blood of well nourished, pregnant women is approximately twice that of fetal blood. Concentration of RBP is the same in maternal and fetal serum and is regulated independently of those of the mother (Wallingford & Underwood, 1986)

The placenta is presumably exposed to all of the circulating forms of vitamin A, predominant among those being retinol bound to RBP. Cell surface receptors for RBP have been reported on the human placenta, which takes up RBP-bound retinol and rapidly degrades it, releasing degradation products to the fetal circulation. The route and mechanism by which retinol traverses the placenta are unknown. The RBP-retinol complex found in fetal circulation, therefore, is not transferred intact from maternal circulation (Dancis et al, 1992). The metabolism of vitamin A is also conditional with respect to its form. There is evidence that food and synthetic forms of retinol may not have equivalent teratogenic potential and fetal exposure to the teratogenic forms of the vitamin might be greater with synthetic vitamin A (Buss et al, 1994). Dimenstein et al, (1996) assessed the placental transfer of retinol and beta-carotene based on maternal serum, cord serum and placental levels at term parturition in women with adequate (≥ 20µg/dl) and sub adequate (≤ 20µg/dl) vitamin A status. The study suggests that beta-carotene may be a precursor of retinol in placenta and that this conversion may depend on the nutritional status of the mother, being particularly effective in a more depleted state. The transfer of other retinoids across the placenta, such as all trans retinol, has been investigated with the prefused human placenta. Thus the compound is transported in plasma bound to albumin. It is rapidly removed from maternal circulation and appears in fetal circulation in a time-dependent manner. Furthermore, the placenta can metabolize this and other retinoids to other compounds, which may be more or less toxic than their parent compounds, which are then released to the fetal circulation. The way the placenta handles these compounds is of concern if their concentration in maternal circulation increases, as might be the case for a few hours after ingestion of a large dose of synthetic retinol (Miller et al, 1993).

Maternal vitamin A status during pregnancy

Dietary intake

Insufficiency of various micronutrients including vitamin A during pregnancy is a matter of concern in view of the reproductive performance and health of the fetus. Several workers have reported inadequate vitamin A intake by pregnant women (Gopalan, 1961; Nirmala et al, 1966; Gopalan and Jayarao, 1972; Vijayalakshmi and Lakshmi, 1983), the deficit reported being in the range of 59-68%. Even after more than a decade's effort in improving nutritional status, the picture is still not satisfactory. Many of the women in developing countries enter pregnancy with inadequate nutrient stores. Such status that may be detrimental to health of pregnant women and their infants is of concern. Furthermore, social and anthropological literature acknowledges the

influence of beliefs of food related behavior during pregnancy, which in turn influences the food intake.

Serum retinol

The serum retinol levels decrease gradually and reach their lowest values at labor (Goodman, 1984; Bates, 1983; Wallingford and Underwood, 1986; Panth et al, 1990). Lund and Kimble (1943) first reported this fall in maternal serum vitamin A during 3rd trimester of pregnancy. It was found that the level of vitamin A in the plasma was lower in the third trimester than in 2nd and that within 48 hours of parturition the level rapidly increased. Gopalan (1961) reported that maternal serum vitamin A level declined from 104 IU (34.3 µg) / 100ml in the first trimester to 88 IU (29.0 µg) in the second trimester and to 67 IU (22.1 µg) in the 3rd trimester. There were, however, no significant changes reported in the serum carotene levels with the advance of pregnancy. This pattern of progressive lowering (Table 2) of serum vitamin A with advance of pregnancy was also observed by others (Pullium et al, 1962; Basu and Arulanaatham, 1973; NIN Ann Rep, 1985-86)

The fall in vitamin A concentration cannot be attributed to hemodilution since the carotene concentration did not show a similar fall. Since vitamin A is known to be excreted in the urine during pregnancy it was thought that this fall in serum vitamin A with the advancing pregnancy could be the result of the urinary excretion. However, Lewis et al (1947), were able to raise the serum vitamin A of pregnant women and prevent the expected decline in the concentration during the 9th month of pregnancy by daily supplementation of 10000 IU of vitamin A which suggests that low intake of vitamin A was probably responsible for this fall. Moreover, this fall has been observed only in low-income group Indians and not in high-income group Indians or developed countries (Panth et al, 1990; Raman, 1991). It is also possible that this phenomenon reflects a change in the equilibrium between the liver and blood vitamin A or the utilization of vitamin A by the fetus. The serum vitamin A levels have been reported as low as about 20 µg/100ml in the 3rd trimester of pregnancy (Gopalan and Jayarao, 1972)

TABLE 2: SERUM CONCENTRATION OF CAROTENE AND VITAMIN A IN PREGNANT WOMEN

Duration of pregnancy	serum carotene (µg /100ml)	serum vitamin A (µg /100ml)	Reference
1st trimester	87.9	34.42	Venkatachalam et al (1962)
2nd trimester	75.4	29.11	
3rd trimester	99.0	22.18	
1st trimester	68.6	29.9	Basu & Arulanantham (1973)
2nd trimester	77.5	23.9	
3rd trimester	93.7	22.9	
24-26 weeks	-	34.7	Panth et al (1990)
28-32 weeks	-	34.1	
34-38 weeks	-	29.5	

Serum carotene

The concentration of carotenoids is reported to increase late in gestation (Panth et al, 1990) and to fall during the first three to six weeks postpartum (Butte et al, 1981; Lipsman, 1985; Wallingford and Underwood, 1986, Kon and Mawson, 1950). However, this does not appear to be a consistent pattern (Dostalova, 1988)

Vitamin A supplementation during pregnancy

Data from India indicate that, unlike anemia, vitamin A deficiency in pregnancy is not associated with increased maternal morbidity and mortality. There is at this time, therefore, no program for universal supplementation to pregnant women. Most deliveries in rural areas take place at home and there is no specific maternal health contact point in the first 8 weeks after delivery when large dose of vitamin A supplementation can be given safely. India does not, therefore have a policy encouraging targeted supplementation to lactating women who contact health services prior to 8 weeks postpartum (WHO, 1997b).

As early as in 1940, Woo and Chu have reported significant differences in the liver vitamin A in infants from China, USA and Finland. Panth et al (1990) supplemented women between 20-28 weeks of pregnancy with 1800 µg of vitamin A in addition with 60 mg of iron daily for eight and 12 weeks. There was no change in plasma retinol concentrations that are characteristic of pregnancy. Cord blood levels of retinol were higher only among the supplemented group.

Maternal night blindness increases the risk of mortality in the first six months of life among infants in Nepal. Clinical benefits of the supplementation have been reported by Christian et al (1998 and 2001) who could significantly reduce (not eliminate) the incidences of night blindness in Nepali pregnant and lactating women by supplementing them weekly with 7000 µg RE as preformed vitamin A or beta-carotene. Women treated with vitamin A + zinc were four times more likely to have their night vision restored than were women in the placebo group. It is concluded that zinc potentiated the effect of vitamin A in restoring night vision among pregnant women with low initial serum zinc concentrations (Christian et al. 2001). Katz et al (2001) found that vitamin A or beta-carotene supplementation increased the rate of twinning or improved the survival of twins in utero but not after birth.

Low doses (0.2 µmol- 8.4 µmol, equivalent to about 200-8000 IU or 60-2400 µg) of vitamin A given to pregnant women increase their plasma retinol values (Rasmussen, 1997). Underwood (1994) has recommended a low-dose supplement daily (2400-3000 µg RE) until term as too few data are available to evaluate fully the safety of providing a high dose at this time. No birth defects have been reported with these doses, although none would be expected as in all these cases embryogenesis was complete before supplementation. The safe daily or weekly dose that can be given to pregnant women is not precisely known; it may depend in part on the women's hepatic reserves of vitamin A. Evidence is lacking that high-dose supplementation at this late period of gestation would have detrimental effects, but definite beneficial outcomes for the newborn also have not been well documented. Massive doses of preformed vitamin A have not been routinely given to pregnant women and so the effect of such a supplementation strategy on maternal and fetal health is not known. However, it is clear that a massive dosing with vitamin A should be avoided during the periconceptional period (Rasmussen, 1997).

Dual supplementation with iron and vitamin A has shown the maximum benefits in both the biochemical parameters indicating an interplay between the two nutrients (Vijayalakshmi and Lakshmi, 1983; Vijayalakshmi and Devdas, 1987; Panth et al, 1990; Shatrugna et al, 1997). Though parameters of iron nutritional status were not consistent with vitamin A supplement, it is possible that vitamin A improves hemoglobin level by improving the absorption or by facilitating better utilization of iron by the bone marrow. This is significant in the context of high prevalence of both anemia and vitamin A deficiency in preschool children and pregnant women. Incorporation of vitamin A with iron/folic acid in the National Anemia Prophylaxis Program requires serious consideration (Raman, 1991). WHO (1997b) has given recommendations on vitamin A dose and timing for the supplementation.

Where vitamin A deficiency is endemic among children under school age and maternal diets are low in vitamin A, health benefits are expected for the mother and her developing fetus from a daily supplement not exceeding 10,000 IU vitamin A (3000 µg RE) at any time during pregnancy or a weekly supplement not exceeding 25000IU vitamin A (8500 µg RE). In this regard a single weekly dose > 25000 IU is not advisable, particularly between day 15 and day 60 following conception. And beyond 60 days after conception, the advisability of a single dose of >25000 IU is uncertain. For fertile women, independent of their vitamin A status, 10,000 IU (3000 µg RE) is the maximum daily supplement to be recommended at any time during pregnancy. There are no recommendations, however, on low dose vitamin A supplementation and duration for the same during pregnancy.

Underwood (1994) has discussed implications of maternal vitamin A supplementation at physiological doses as a potential strategy to improve infant and child vitamin A status in developing countries. According to her, where health care infrastructures make contact with women during pregnancy and within the first month of postpartum, the potential exists for improving their status through diet and/or high dose supplementation. The preferred intervention is through a diet that provides a safe concentration of intake throughout pregnancy and lactation. Use of supplement during pregnancy presents a logistic problem in most developing countries because it is only safe to give a near physiological dose daily and few health systems have such frequent contacts with mothers. However, physiological doses do not require the strict supervision of the medical system. Thus, there is the potential in tapping into other community delivery systems to meet this need, such as through mothers' groups, local pharmacies, or family planning programs. Innovative approaches adapted to different settings are needed.

Vitamin A status of lactating women

Dietary intake

Few studies since 1975 report on the dietary vitamin A intake of lactating women. Marginal vitamin A status is common among lactating women. The mean daily intake by Indian lactating mothers has been reported to be in the range of 24-180 RE (Sundararaj and Pereira, 1975; Girija, 1984). The weighted average daily intake by unsupplemented women in developing countries (660 RE/day) is less than half that of women in developed countries (1,540 RE/day). This is lower than the 850 RE per day safe level for lactating women but above the basal requirement of 450 RE/day recommended by the FAO/WHO. Most of the mean intake figures from developing countries, with a few exceptions (Zeitlin et al, 1992; Geissler et al, 1978), were well below 850 RE.

Serum retinol

Serum retinol levels decrease during pregnancy and increase to non-pregnant levels during the postpartum period (Goodman, 1984; Bates, 1983; Wallingford and Underwood, 1986; Panth et al, 1990). The increase to normal values occurs within 24-48 hours postpartum (Roy et al, 1989; Wallingford and Underwood, 1986). The concentration of retinol in the serum of lactating women is not significantly different from that in non-pregnant, non-lactating women but is higher than at term (Wallingford and Underwood, 1986). After the increase, there appears to be a slow decrease during lactation (Cumming and Briggs, 1983; Kusin et al, 1985; Stoltzfus, 1993). Several studies on lactating women (Roy et al, 1989; Panth et al, 1985; Venkatachalam et al, 1962) reported a mean serum levels of retinol in the deficient range (< 20 µg/dl) or the marginal range (20-30 µg/dl).

Serum carotene

The effect of parturition on serum carotene appears from reports to be opposite to that of retinol. The concentration of carotenoids is reported to increase late in gestation (Panth et al, 1990) and to

fall during the first three to six weeks postpartum (Butte et al, 1981; Lipsman, 1985; Wallingford and Underwood, 1986, Kon and Mawson, 1950). However, this does not appear to be a consistent pattern (Dostalova et al, 1988). The studies on serum carotene levels in lactating women from developing countries have reported mean values ranging from 71.8 - 187 µg/dl (Newman, 1993).

Serum retinol-binding protein
All mean serum RBP levels in lactating women from developed countries were in the recommended adequate ranges [>26 mg/l (Gibson, 1990) or >= 30 mg/l (Jensen et al, 1983)]. However, two studies (Roy et al, 1989; Gebre-Medhin et al, 1976) reported mean levels of 26 mg/l or less, but neither observed levels in the deficient range (<22 mg/l).

Vitamin A in breast milk
Retinol derived from the circulating RBP-retinol complex and chylomicron-associated vitamin A is transferred from blood to milk. Most of it is re-esterified in the mammary glands and occurs as retinyl esters in milk (Bates, 1983; Ross, 1982). The chylomicron-associated vitamin A may be a particularly important route of transfer among women who receive chronic low doses of the vitamin as well as periodic acute doses. Both low daily doses and periodic massive doses of vitamin A increase the concentration of retinol in human milk (Rasmussen, 1997). Whereas most of the vitamin A activity in mature human breast milk is in the form of retinol (retinyl esters), some is provided by carotene. Beta-carotene is stored in the mammary glands during pregnancy and is rapidly secreted into milk during the first few days of lactation (Patton et al, 1990). Thus, carotene provides almost 20% of the retinol equivalents during the first day, but this drops to less than 5% by the end of the first week (Newman, 1993). Unlike retinol, beta-carotene is a very effective antioxidant and thus provides the infant a defense against oxygen toxicity (Ostrea et al, 1986; Flodin, 1988; Kirksey and Rahminifar, 1988). This may be particularly important during the first several days of life, as the infant adjusts to its new oxygen-rich environment.

The vitamin A content of human milk is significantly affected by maternal nutrition during pregnancy and lactation (Lonnerdal, 1986; Ministry of Health and Family Welfare, 1991; Ibrahim et al, 1991; Ortega et al, 1997). The fat content of the milk, time after birth (postpartum age), gestational age at birth, parity of the mother, and individual variation also have an influence. The use of oral contraceptives is reported to affect the amount of retinol in human milk. Thus, it is important to consider these factors when evaluating milk vitamin A levels.

Maternal vitamin A nutriture and breast milk vitamin A
Relatively few studies compared breast-milk vitamin A levels with the intake of retinol or retinol equivalents by lactating women, or directly compared the breast-milk concentration in well nourished and poorly nourished communities. According to several investigators, the amount of vitamin A in milk decreases with maternal deficiency of the vitamin and increases with excessive intake (IM, 1991; Bates, 1983; Gebre-Medhin et al, 1976; Hrubetz et al, 1945; Ajans et al, 1965; Naismith, 1985; Butte, 1981; Rasmussen, 1997). Retinol in colostrum and transitional milk in low-income Indian women is found to be in the range between 257 RE/l and 1453 RE/l (Barua, 1973; Belavady and Gopalan, 1959). Also, data on maternal serum retinol and body mass index (BMI) were positively associated with milk retinol level in a multiple regression analysis of data on 153 rural Indonesian women (controlled for milk fat content) (Stoltzfus et al, 1993). Thus heavier and presumably better nourished women had higher levels than thinner women who were less well-nourished. However, no association was seen between maternal intake of retinol and carotene and the corresponding values in the milk of well-nourished Canadian women (Chappell et al, 1985), probably indicating adequate liver stores.

Mature milk of well nourished women contains around 2-3 mmol/l of vitamin A as against the value of 1mmol/l reported from the areas where vitamin A deficiency is common. At this low level, it is estimated that the infant will accumulate no storage vitamin A - a state of sub clinical vitamin A deficiency. Supplementations of the mothers with low daily doses and periodic massive doses of vitamin A increases the concentration of retinol in the milk and thus provides substantial amounts of the vitamin to the infant. Further, transfer of vitamin A from maternal blood to breast milk is regulated primarily by levels of maternal retinol-binding protein bound retinol (RBP-R). Low maternal zinc status, protein-energy malnutrition and situations that activate an acute-phase response, all reduce levels of RBP and as a consequence cause reduced RBP-R which in turn could limit the retinol transferred to milk (Stoltzfus, 1994; Allen, 1994).

Overall, there are considerable differences in the vitamin A (retinol plus beta-carotene) of the milk of unsupplemented mothers in developed countries and developing countries. The range of retinol in presumably well-nourished women in developed countries was about 330-1,130 RE/l, and the range of carotene was about 10-65 RE/l. In developing countries, the corresponding ranges were 170-790 RE/l and about 40-47 RE/l. During the first six months of lactation, the retinol content of mature milk from mothers delivering at term averaged approximately 660 RE/l in developed countries and approximately 330 RE/l in developing countries. According to the Institute of Medicine (IM, 1991), infants who consume human milk that provides 100-151 RE/l grow well and do not show signs of vitamin A deficiency. Thus, even though the retinol content of milk from mothers in developing countries averages about 50% of that of mothers from developed countries, it is sufficient to meet infant needs, even without counting the equivalents from carotene. The carotene content of human milk appears to be affected by maternal dietary intake and nutrition status. Approximately only 5 % of the vitamin A of breast milk in developed countries comes from carotene, as compared to over 10% in developing countries (Newman, 1993).

Along with ensuring adequate vitamin A levels in breast milk for the infant, improving the vitamin A status of lactating women may benefit maternal health directly. Recent studies in human studies indicate that an adequate dietary intake of retinol and carotene helps to prevent breast and cervical cancer (Agarwal et al, 1991; Basu et al, 1991, Brisson et al, 1989; Engle et al, 1991; Herrero et al, 1991; Potischman et al, 1991). Studies in animals indicate that vitamin A protects females from infections. For example, cows with mastitis had significantly lower retinol levels postpartum than cows without mastitis (Johnson and Chew, 1984). Vitamin A supplementation protected rats and mice against experimentally induced uterine and mammary gland infections (Inaba et al, 1989; Chew et al, 1984). Supplementation of vitamin A and beta-carotene improved mammary health in dairy cows around dry-off (weaning) periods (Tjoelker et al, 1990).

In field trials, high dose postpartum supplementation with vitamin A has consistently increased the vitamin A content of breast milk for at least six months. Placebo-controlled studies using a single postpartum vitamin A dose of 200,000 IU to 300,000 IU have been conducted in Bangladesh (Rice et al, 1999; Roy et al, 1997), India (Bhaskaran and Balakrishna, 1998), Indonesia (Stoltzfus et al, 1993), and Thailand (Thanagkul et al, 1974). Larger and longer lasting improvements in milk vitamin A content were observed when higher doses were used. Improving the vitamin A status of the mother will increase the vitamin A content of breast milk and this will mean more vitamin A for the breast-feeding infant. Vinutha et al (2000) indicated a high incidence of inapparent vitamin A deficiency (29.7%) in pregnant women in the low socio-economic group residing in Mumbai.
A single dose of 2 lakh units of oral vitamin A given within 48 hours after delivery resulted in a significant increase in the breast milk and infant serum retinol levels at least for a period of three months postpartum. The efficiency with which vitamin A ingestion by well nourished mothers is transferred to their milk is not readily defined.

However, in vitamin A-depleted women and those with continuous low intakes, dietary supplements generally increase the concentration in milk (Belavady and Gopalan, 1969; Bura, 1973; NRC/CLS/FNB, 1989). Since the concentration of retinol in breast milk is generally higher than in the mother's blood, it is assumed that the mammary glands possess active transport systems. Green et al (2001) have demonstrated with models based on rat experiments that dietary vitamin A, like triglycerides, may be directed to mammary tissue during lactation for preferential secretion into milk; thus increasing vitamin A intakes will increase the contribution of dietary vitamin A to milk. In contrast to milk, mammary tissue vitamin A turns over very slowly. However, the absorption capacity of the mammary glands seems to respond to vitamin A intake only up to saturation, thereby protecting the infant against vitamin overdose (Dostalova et al, 1988). Although the vitamin A concentration of colostrum or milk can be increased about fourfold by promptly loading the mother with high-dose supplements, the resulting amount secreted into breast milk is nowhere near the toxic dose of 6000 RE /day for infants

Toxicity considerations

When ingested in large amounts, retinol causes toxicity, including liver damage, bone abnormalities, desquamation, alopecia, diplopia, vomiting and headaches. It also can cause spontaneous abortion and birth defects, such as deformities of cranium, face, heart, thymus, kidneys and cerebral nervous system. Toxicity usually begins to occur in infants with daily doses of 6,000 RE (20,000 IU) and in adults at daily doses of 7,500 RE (25,000 IU) for a prolonged period of time. Birth defects attributed to vitamin A have been reported in the fetuses of women ingesting 7,500-45,000 RE (25,000-150,000 IU) daily early in pregnancy. Because of the risk of such congenital malformation, women who are or who might become pregnant should carefully avoid taking supplements exceeding 3,000 RE (10,000 IU) (FAO, 1988). Except for the livers of mammals and fish, foods consumed in usual quantities do not contain sufficient quantities of vitamin A to induce toxicity. Large quantities of carotenoids in foods may cause some coloration of the skin but are otherwise harmless (FAO/WHO, 1988 and NRC/CLS/FNB, 1989).

Conclusions

Reproduction, embryogenesis, differentiation, hematopoesis, bone development, and vision are all dependent on vitamin A. Basal daily requirements of vitamin A, if not safe levels, are therefore, necessary during pregnancy and lactation to prevent the clinical and sub-clinical deficiency symptoms in mother as well as to ensure sufficient fetal liver stores and breast milk vitamin A content. Practical implications of single high dose vitamin A supplementation during lactation have been well studied. Teratogenic effects of high dose supplementation demands careful monitoring. Use of beta-carotene supplements holds a promise in this context. However, pertinence of the continual low dose at physiological level during pregnancy has to be considered for its benefit of safety. Precise dose and frequency schedules have to be tailored in compliance with the deficiency prevalence. Having recognized the upshots of maternal vitamin A deficiency during pregnancy, an absence of universal supplementation program for pregnant women in India needs serious rethinking. While addressing vitamin A scarcity as a micronutrient deficiency, its intimate relationship with other micronutrients like zinc, selenium, iron and macronutrients fat and proteins cannot be overlooked. Hence, single nutrient approach with synthetic vitamin A needs to be appended with its multi-nutrient approach.

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PROFILE OF COLOURS IN FOODS AVAILABLEIN BANGALORE MARKET

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A survey was undertaken to find out the extent of fraudulent use of synthetic colours in selected food items. A total of 45 samples of sweet meats, bakery products and savouries were analyzed for the presence of permitted and non-permitted colours. Of the analyzed samples 9.09, 68.18, and 22.72 per cent of sweetmeats and 11.76, 70.58 and 29.41 per cent of savouries contained permitted colours, non-permitted colours and a combination of both respectively. It was observed that 27.27 per cent of sweetmeats and 58.82 per cent of savouries contained colours above the permissible limit prescribed by the PFA in the range of 108-255.5 ppm and 100.47-282.84 ppm respectively. Congo red was the predominant non-permitted colour used in the food items. So proper programme should be undertaken to educate people regarding the laws and ill-effects of using non-permitted colours as well as permitted colours above the permissible limits.

KEY WORDS: permitted colors, non-permitted colors, sweet meats, bakery products, savouries, Congo red

Colour is a vital constituent of food, which imparts a distinct appearance to the food product. Colour renders food appealing and appetizing. A wide range of coloured foods are available in the market which are coloured with many types of dyes (natural, synthetic and even textile dyes). Natural food colours are extracted and isolated from different plants and animals, so they have no harmful effect. Synthetic dyes were originally derived from coal-tar and were commonly called as coal-tar dyes. They contain the azo group. Azo group compounds are toxic and are potential carcinogens. Azo group food colourants are especially harmful to human beings and cause a number of allergic reactions including migraine, headaches, blurred vision, itching, rhinitis, skin blotching, nettle rash and water retention (Guler 2005). Synthetic colours are of two types i.e. permitted and non-permitted. Synthetic colours are added to food to provide a colourful identity, to match the flavour and to create a festive appearance. In India, the use of food colour is regulated under the Prevention of Food Adulteration Act (1954). Presently eight synthetic colours are permitted to be added to specified food items in India. These include Carmoisine, Ponceau 4R, Erythrosine, Sunset yellow, Tartrazine, Brilliant blue, Indigo carmine and Fast green with a maximum permissible level of 100ppm in the final food or beverage. However, the level of 200ppm has been permitted in certain foods such as canned peas, strawberries and jams (Rao *et al*, 2002). Because of cheaper cost and easy availability of several low cost non-permitted food colours unscrupulous traders, have been tempted to use such non-permitted food colours in various food products. Non-permitted colours such as Auramine, Metanil yellow, Rhodamine, Malachite green, Orange II, Amaranth, Fast red and Sudan are cheap and readily available and hence are believed to be commonly used. Non-permitted colours, excessive amounts of permitted colours and inclusion of colours in those foods which are not permitted to carry colour, may constitute serious public health hazards. Non-permitted colours alter enzyme reactions in the human body and are mutagenic. So, the present survey was undertaken to find out the extent of fraudulent use of synthetic colours in a few selected items of food articles where in only synthetic colours are used.

MATERIAL AND METHODS

A total of 47 samples of sweetmeats, bakery products and savouries were collected at random from different shops of Bangalore North. The samples were analyzed for the presence of permitted and non-permitted colours and the extent of use of these colours in the food products. The presence of twelve standard synthetic food colours were examined, of which five were permitted colors and seven were non-permitted colours. The permitted colours included Tartrazine GR, Erythrosine B, Carmoisine A, Indigo carmine BGR and Fast green FCF. The non-permitted colours examined were Auramine O, Congo red, Methyl orange, Metanil yellow GR, Rhodamine BGR, Brilliant green and Sudan III. Chemical analysis of the coloured foods was carried out spectorphotometrically. The extraction of the dyes from the food samples was done using the wool-dye technique (Ranganna 1986).

RESULTS AND DISCUSSION

A total of 22 sweet meat samples were analyzed. Out of which 40 per cent (n = 9) were from sweet meat shops and 60 per cent (n = 13) were from street vendors. Only 9.09 per cent samples contained permitted colours whereas 68.18 per cent samples contained non-permitted colours and 22.72 per cent samples contained a combination of both permitted and non-permitted colours. Ashfaq and Masud (2002) analyzed 73 different samples of sweet meats and confectioneries. The results revealed that 58.5 per cent of samples contained permitted colours where as 46.5 percent contained non-permitted colours. According to the PFA act, the maximum permissible limit for addition of permitted colours in the sweet meat samples is 100 ppm, but among the analyzed samples 27.27 per cent of samples contained colours above the permissible limit (108-255.5 ppm). It was observed that 80 per cent of the samples from the street vendors contained non-permitted colours whereas only 20 per cent of samples from sweet meat shops contained non-permitted colours. The addition of colour was higher in the street vendor samples. Among the sweet meats, jehangir and batasa sold by the street vendors contained colours in the range of 118-255 ppm. Green burfi and kesaribhath from the sweet meat shops contained the least amount of colours i.e. 13-16 ppm (Table 1).

A total of 17 samples of savouries were analyzed of which 70.58 per cent (n = 12) samples contained non-permitted colours and 11.76 per cent (n = 2) samples contained permitted colours (Table 2). Few of the food samples i.e. 29.41 per cent (n = 5) contained both permitted and non-permitted colours. It was observed that majority of the samples collected from street vendors contained non-permitted colours. Congo red was observed in 58.82 per cent of samples. The maximum permissible limit according to PFA for savouries is 100 ppm; however 58.82 per cent samples in the present study contained colours above the permissible limit in the range of 100.47 ppm to 282.84 ppm.

The concentrations of permitted and non-permitted colours in bakery products has been presented in Table 3. Eight samples of bakery products were analyzed, of which four samples were cream biscuits and four were cakes. Among the four different cream biscuits one sample contained an unidentified brown colour. One sample of cream biscuit contained a non-permitted colour Auramine O (75.40 ppm) alone. All the remaining six samples contained both permitted and non-permitted colours. It was observed that out of the four cake samples three samples exceeded the permissible range of colours according to PFA act i.e. (103.1-136.4 ppm). Rao *et al.* (2004) analyzed 315 coloured food samples, 95 per cent of the foods contained permitted colour while 5 per cent of foods used non-permitted colours. Two samples such as cream biscuit and ragi contained an unidentified brown colour. Of the analyzed samples, 34.95 per cent (n = 36) exceeded the permissible limit for food color. The yellow coloured samples contained both

Tartrazine GR and Auramine O. In the icing cakes Erythrosine B, Carmoisine A and Congo red were used for giving an attractive look.

Table 1: Permitted and non permitted colours in sweet meats

Sl. No.	Name of the product	Source	Permitted colour		Non-permitted colour		Total conc. of colour (ppm)
			Name of the colour	Conc. (ppm)	Name of the colour	Conc. (ppm)	
1	Laddu	S	-	-	Auramine-O	74.76	74.76
2	Laddu	SS	Tartrazine-GR	35.57	Methyl orange	17.24	52.81
3	Jelabi	S	Tartrazine-GR	27.17	Auramine-O	12.41	39.59
4	Jelabi	SS	Tartrazine-GR	49.75	Auramine-O	22.30	72.05
5	Jehangir	S	-	-	Congo red	255.70	255.70
6	Jehangir	SS	-	-	Methyl orange	44.84	44.84
7	Rosgolla	SS	Tartrazine-GR	47.10	-	-	47.10
8	Coconut burfi	S	-	-	Methyl orange	50.22	50.22
9	Coconut burfi	SS	Tartrazine-GR	94.73	Auramine-O	30.65	125.38
10	Burfi	SS	Fast green FCF	13.02	-	-	13.02
11	Bombay Halwa	S	-	-	Congo red	22.01	22.01
12	Bombay Halwa	SS	-	-	Congo red	28.11	28.11
13	Peda	S	-	-	Methyl orange	84.85	84.85
14	Samosa	S	-	-	Methyl orange	36.00	36.00
15	Badusa	SS	Tartrazine-GR	35.82	Methyl orange	18.89	54.71
16	Kaduri Mithai	S	-	-	Methyl orange	108.20	108.20
17	Mysore Pak	S	-	-	Auramine-O	22.93	22.93
18	Batasa	S	-	-	Auramine-O	118.67	118.67
19	Batasa	S	-	-	Rhodamine-BGR	207.80	207.80
20	Batasa	S	-	-	Methyl orange	137.38	137.38
21	Kesaribhath	SS	-	-	Methyl orange	16.62	16.62
22	Kesaribhath	S	-	-	Auramine-O	87.30	87.30

S – Street vendors SS – Sweet meat shops - Absence of colours

Table 2: Permitted and non-permitted colours in savouries

Sl. No.	Name of the product	Source	Permitted colour		Non-permitted colour		Total conc. of colour (ppm)
			Name of the colour	Conc. (ppm)	Name of the colour	Conc. (ppm)	
1	Gobi Manchurian	S			Congo red	138.06	138.06
2	Gobi Manchurian	SS	Carmoisine A	20.22	Congo red	75.54	95.76
3	Potato chips	HC	Fast green FCF	8.37	-	-	8.37
4	Bitter gourd chips	HC	-	-	Congo red	239.79	239.79
5	Salted groundnut	S	-	-	Congo red	113.60	113.60
6	Fried green peas	S	Fast green FCF	78.82	Brilliant green	22.02	100.84
7	Puffed rice laddu	S	Tartrazine GR	18.86	-	-	18.86
8	Puffed rice laddu	S	-	-	Rhodamine BGR	1.86	1.86
9	Chicken kabab	R	-	-	Congo red	99.70	-
10	Chicken kabab	S	-	-	Sudan-III	47.21	146.91
11	Fish fry	R	-	-	Congo red	127.26	127.26
12	Fish fry	S	-	-	Congo red	68.96	68.96
13	Egg fried rice	S	-	-	Congo red	208.03	208.03
			-	-	Congo red	87.42	87.42
14	Fryums	S	-	-	Auramine O	214.00	-
			-	-	Brilliant green	108.18	132.18*
			-	-	Rhodamine BGR	74.38	-
15	Fryums	SM	Tartrazine GR	345.17	Auramine O	229.18	-
			Erythrosine B	59.21	Brilliant green	37.71	-
			Carmoisine A	135.77	Congo red	116.05	282.84*
			Fast green FCF	107.50	Methyl orange	100.78	-
16	Sago papad	SM	Tartrazine GR	55.23	Auramine O	35.35	-
			Erythrosine B	17.56	Brilliant green	3.77	46.43*
			Carmoisine A	10.85	Methyl orange	28.41	-
			Fast green FCF	12.06	-	-	-
17	Tomato sabudana wafers (Nandi Food Products)	SM	Erythrosine B	83.86	Methyl orange	16.61	100.47

S – Street vendors SS – Sweet meat shops HC – Hot chips R – Restaurant
SM – Super market
* Average of permitted and non-permitted colours - Absence of colours

Table 3: Permitted and non permitted colours in bakery products

Sl. No.	Name of the product	Source	Permitted colour		Non-permitted colour		Total Conc. of colour (ppm)
			Name of the colour	Conc. (ppm)	Name of the colour	Conc. (ppm)	
1	Local cream biscuit	S	Tartrazine-GR	62.02	Auramine-O	17.43	79.45
2	Local cream biscuit	S	Tartrazine-GR	43.35	Auramine-O	18.24	61.59
3	Local cream biscuit	S			Auramine-O	75.40	75.40
4	Local cream biscuit	S	Un identified brown colour		-	-	-
5	Plain cake	S	Tartrazine-GR	69.50	Auramine-O	33.60	103.10
6	Plain cake	B	Tartrazine-GR	80.61	Auramine-O	28.13	108.74
7	Icing cake	B	Tartrazine-GR	17.90	Auramine-O	0.88	18.78
8	Honey cake	B	Erythrosine-B	46.92	Congo red	49.85	136.40
			Carmoisine A	39.63	-	-	-

S – Street vendors B – Bakery - Absence of colours

CONCLUSION

The results of this study revealed the occurance of permitted colouring matter as well as indiscriminate use of non-permitted colours in the food products selected for the study. The finding's reveal that some food products contain both permitted colours along with non-permitted colours. Due to cost-effectiveness and easy availability the permitted colours are adulterated with the non-permitted ones. It is felt that proper programmes should be undertaken to educate the people regarding the laws and the ill-effects of using non-permitted colours as well as permitted colours above the permissible limits. It is also necessary to educate the street vendors and small scale food manufacturers about the toxicity of using non-permitted colours in their food products.

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STUDY OF BURN-OUT PRINTING ON POLYESTER/WOOL BLENDS

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Burnout printing involves the chemical destruction of one component of a composite fabric using acid liberating agents. This study aimed at standardizing the process for burnout printing on polyester/wool composite fabrics using alkali as the burnout reagent. The burnout printing was done using the following variables : fabric characteristics (blends of 55/45 and 65/35, plain, twill and satin base weaves and light and dark colors) and process conditions (5% and 10% alkali concentration, 130°C and 160°C drying temperature and 5, 10 and 15 minutes drying time). A survey was conducted to arrive at preferences based on print sharpness, transparency, feel and overall appearance. Burnout samples of 55/45 blend composition was more preferred to 65/35 blends. Print sharpness of plain and satin base weaves; the transparency of plain and twill weave and the surface feel of satin base weaves were the attributes preferred. Alkali concentration did not have an influence on the print effectiveness. Drying at 160°C produced better prints than drying at 130°C irrespective of the duration of drying. Burnout printing was preferred for furnishing and upholstery fabrics, men's shirts and ladies tops.

KEY WORDS: Burnout printing, plain weave, twill weave, satin weave, polyester/wool blend

Burnout printing

Devore or burnout style of printing, describes a process of chemically destroying a component of a composite fabric. The burnout or devore style, which is achieved by chemical means, was called "broderie chimique" in Europe because it can be used to give the effect of machine embroidery. Normally the burnout technique uses protein – cellulose or synthetic – cellulose composite fibers especially constructed for this purpose (http://www.dyeman.com/devore.html).

The term carbonisation has been originally associated with wool for chemical destruction of vegetable matter in it. Its use in printing, however, is associated with polyester cellulose blended fabrics. Burnout involves the destruction of all, or at least part of the fabric in the printed areas of the pattern. This, of course, can happen accidentally in a number of styles if the chemical processes are not controlled properly but in the 'burnout' or 'devore' style, the removal of part of the substrate is essential to obtain the desired effect (Prayag, 1989).

The principle is quiet simple and entails the use of a print paste, which contains an acid capable of dissolving or destroying the fabric in the printed areas, during subsequent processing. Any fabric can be subjected to such a process provided that a suitable reagent is used, which can be adequately controlled during processing (e.g. can be suitably thickened to give a print paste), and which is not harmful to operatives or machinery (Miles, 1981).

Burnout style is also termed 'Brasso' style. Blended fabrics of polyester and cellulosic fibers in particular are popularly employed for this style wherein the cellulosic portion is "burnt" or destroyed by mineral acid-liberating salts like aluminum sulphate. The chemical is applied by printing and then subjected to heat treatments wherein the released sulphuric acid destroys only

the cellulosic portion of the blend at the printed places leaving the polyester (Shah, 1994).Burn-out printing is the process of printing a design on flat fabrics composed of different fiber types with a paste containing chemicals capable of dissolving / destroying one of the fiber components. Fabrics resembling lace have been produced in this way for shirting's and other fashion articles (Rouette, 2001).

If the fabric is very thick only the surface will be in contact with the burnout paste. This can be used for relief effects on velvets and velour. If the back of the velvet is synthetic or protein, the pile can be totally removed by printing the burnout on the backside of the fabric (http:// www.dyeman.com/devore .html.).

Burnout effects can also be created on velvets made of blended fibers, in which the ground fabric is of one fiber like polyester, and the pile may be of a cellulose fiber like viscose rayon or acetate rayon. In this case, when the chemical is printed, it destroys the pile in those areas where the chemical comes in contact with the fabric, but leaves the ground fabric untouched (http: // allaboutfabrics.com / index.html).

Earlier uses of this style were on cotton to give novel dress-fabric effects, but the introduction of polyester–cellulose mixtures has widened the scope considerably. The polyester portion of such mixtures is virtually unaffected by the reagents used to destroy the cellulose portion and allows the production of sizeable 'burn-out' effects with adequate strength and stability retained.

The amount of burnout chemical to be used depends on many different factors including: compositions of mixed fabric, weave of the fabric, burnout conditions and printing technique. (Mundkur, 1985)

Polyester / wool blend

The reasons for combining different fibers are to affect economics in raw material costing where one fiber in the blend is relatively expensive; to improve the performance by modifying physical properties and to confer aesthetic qualities by introducing color contrasts (Cheetham, 1966).
Polyester / wool blends are very well accepted world over because they combine the most desirable wear and warmth qualities of wool and dimensional stability, light weight and easy care properties of polyester. In combination with wool, polyester provides outstanding wrinkle resistance and crease retention, so that wet or dry, the shape retention is improved according to the proportions used. The greater abrasion resistance of polyester also provides longer wear. The wool contributes good draping quality and elasticity. The greater the proportion of the wool, the less the pilling there is likely to be (Gulrajani, 1990).

Blends of polyester and wool generally range from 65% polyester and 35% wool to 60/40, 55/45 and 50/50, respectively. For lightweight, shape retentive summer suiting, 65% polyester and 35% wool is a satisfactory blend. A blend of 55% polyester and 45% wool is suitable for year – round garments. The blended fabrics are mainly intended for outerwear such as men's suiting, women's suiting, dresses, skirts (pleated and unpleated) (Gulrajani, 1990).

In the review of literature, works related to the burnout style of printing were identified on pure cellulosic or on composite fabrics such as polyester/cotton, polyester/viscose, nylon/viscose, silk/viscose. In order to carry out burnout printing, different acid liberating agents such as aluminium sulphate, sodium bisulphate, sulphuric acid (70%), burnol, sarocet, etc. were used. There is evidence of the possibility of burnout printing on polyester/wool composite fabrics using alkali and indicating scope for further research.

"Shah (1994) reported that blended fabrics of polyester and cellulosic fibers in particular are popularly employed for this style wherein the cellulosic portion is 'burnt' or destroyed by mineral acid – liberating salts like aluminium sulphate. The other known blends for burnout styles are nylon/viscose or acetate fibers, triacetate/viscose, polyester/wool or silk, acrylic/cellulosic fibers, etc. For 'burning – out' cellulosic fibers or cellulose acetate with nylon, the chemical used is benzoyl peroxide and benzoyl acetate. For 'burning out wool or silk in Polyester blends, the chemical employed is caustic soda."

"Perkuhn (1986) reported that burnout printing is the destruction of one or several types of fibers forming the components of a blend by means of chemicals. The types of fiber blends and fabric constructions suitable for burn – out printing are listed. The types of chemicals, together with the types of fibers they are effective on are examined. The actual burning – out process can be carried out in hot air or steam, following which the fabric is washed (preferably with some mechanical action) to remove the so–called ash."

Table 1: Burnout agents and fiber materials

Fibers	Aluminium Sulphate	Sodium Hydrogen Phosphate	Caustic Soda	Benzoic Peroxide
Cotton	+	+	-	-
Viscose	+	+	-	-
Linen	+	+	-	-
Polyester	-	(-)	(-)	-
Polyamide	-	+	(-)	-
Triacetate	-	+	(-)	+
Acetate	-	+	(-)	+
Wool	-	-	+	-
Silk	-	-	+	-

Fiber is: + destructible, - resistant, (-) partially resistant
(Source: Textil Praxis International, 1986 and Rouette, 2001.)

"Nandy, Mishra et al. (1999) found that the aesthetic and comfort related properties of polyester fabric can be improved appreciably by treating it with 5% NaOH in the presence of 20% methanol at 60°C for 60 minutes without greatly deteriorating its mechanical properties. Attempts were made in the study to improve the feel and handle and comfort related properties of polyester fabrics using minimum amount of sodium hydroxide in the presence of methanol as an accelerator without much deterioration in its mechanical and chemical properties, keeping the weight loss at a desired level (below 5%). The objective of using minimum quantity of sodium hydroxide was mainly to reduce the effluent load, as higher concentration of sodium hydroxide increases the total dissolved solids (TDS) of the effluent. Thus, there is a lot of scope to substitute cotton rich polyester blended fabric with polyester rich cotton blend."

Devore or burnout printing produces a "lace" effect of transparent/ translucent areas and opaque areas. It relies upon one of the fibers being degraded by components in the print paste leaving the other fibers as an open network. A lot of experimentation is needed to achieve good results (http://www.dye-recipes/ devore.html).

Thus the purpose of the present study was to investigate the possibility of burn-out printing of polyester/wool blend using an alkali as the burnout reagent by printing at optimum conditions and to evaluate the effectiveness of prints produced.

The specific objectives of the study were as follows:

1) To derive a recipe for burnout printing on polyester/wool blends using alkali (caustic soda) as a reagent.
2) To arrive at the optimum concentration of alkali to achieve the burnout prints.
3) To note the optimum temperature and time for drying subsequent to burnout printing.
4) To compare the burn-out prints on polyester/wool blends with –
   - 55/45 and 65/35 blend compositions,
   - plain, twill and satin base weave,
   - light and dark colors.
5) To define the scope for burnout printing on polyester/wool blends.

MATERIALS AND METHODS

The present study was conducted to investigate the possibility of burnout printing and to standardize the procedure with optimum conditions producing effective burnout prints. Burnout printing was done on 55/45 and 65/35 polyester/wool blend compositions, with plain; twill and satin base weave structure of light and dark colors. Alkali concentration of 5% and 10% on the weight of print paste, drying temperature of 100° C, 130° C and 160° C and drying time of 5, 10 and 15 minutes were the conditions used.

It was hypothesized that blend compositions, weave of the fabric, color of the fabric, alkali concentration, drying temperature and duration of drying the printed samples would affect the burn-out effects. Accordingly, two hundred and sixteen samples were screen-printed using the different variables (Refer Table 2) of which the most preferred twenty eight were selected for the final survey.

Table 2: Sampling

VARIABLE NAME	*VARIABLE ATTRIBUTE*	*NO. OF VARIABLES*
FABRIC CHARACTERISTICS		
1. Polyester/Wool blends	55/45 and 65/35	2 x
2. Weave	Plain, Twill and Satin base	3 x
3. Color of Fabric	Light and Dark	2 x
PROCESS CONDITIONS		
4. Concentration of Alkali (on the weight of print paste)	5% and 10%	2 x
5. Drying temperatures (°C)	100, 130 and 160	3 x
6.Duration of drying (minutes)	5, 10 and 15	3 x
	Total samples	**= 216**

Preparation of screen: Print sharpness, fineness in design and backgrounds burnt out with raised designs were the points taken into consideration when selecting the design for burnout printing. Exposing the screen using the photochemical process involved: A mixture of photo coat and photo sensitizer (1:3 ratio), applied on the screen surface, was dried for 20 minutes and exposed to artificial light for 8 minutes. The screen was then washed under tap water.

Preparation of print paste: The printing paste was prepared using 5% and 10% concentration of alkali on the weight of print paste (o.w.pp.)

Table 3. Contents of the print paste.

Alkali Concentration / *Ingredients*	*5% (o.w.pp.)*	*10% (o.w.pp.)*
Polybinder	75 parts	70 parts
Glycerine	5 parts	5 parts
Caustic soda	5 parts	10 parts
Indalca Gum	5 parts	5 parts
Water	10 parts	10 parts
Total	**100 parts**	**100 parts**

Method of Mixing: Polybinder, gylcerine, caustic soda flakes, indalca gum and water were weighed. Polybinder and gylcerine were mixed in a plastic container with a continuous stirrer. Caustic soda flakes were dissolved in water and gradually added to the mixture of polybinder and glycerine. Then indalca gum paste was mixed thoroughly to form a consistent print paste. *Precaution was taken by wearing a facemask and gloves for protection during printing, drying and washing of the samples.*

Printing: Printing was done using 5% and 10% alkali concentrated burn-out print paste with drying temperature of100°C, 130°C and 160°C and drying time of 5, 10 and 15 minutes.
While printing it is necessary to make sure the print paste penetrates the fabric well. The number of strokes manually required depends upon the pressure applied. At least three strokes were made for the paste to penetrate evenly into the fabric. The printed samples were dried in a drying oven at varied temperatures (100°C, 130°C and 160°C) and time periods of 5, 10 and 15 minutes.
Completion of drying was indicated by the change in color brown of the printed portions. The dried samples were washed in hot soap solutions to thoroughly remove the print paste and the burnt out wool fibers. Intermediate washing and drying of the screen between printing operations was done to keep the screen clean.

RESULTS AND DISCUSSIONS

In order to standardize the process of burnout printing and to determine the optimum conditions for producing effective burnout prints, the following six variables were considered, pertaining to fabric characteristics and process conditions namely, fabric blend compositions (55/45 and 65/35), weave structure (plain, twill and satin base), color of the fabric (light and dark), concentration of alkali in the print paste (5% and 10%), drying temperature (100°C, 130°C and 160°C) and drying time (5, 10 and 15 minutes).

Visual inspection of all the samples was done in sets of three (a group of three samples dried for 5, 10 and 15 minutes) with 5% and 10% alkali concentration and dried at 100°C, 130°C and 160°C. Comparisons were made for the fabric of 55/45 and 65/35 blend compositions separately amongst the three weaves of plain, twill and satin base. The criteria for the visual assessment were print sharpness, transparency, feel and overall appearance of the fabric. The results of the visual assessment and comparison are discussed in detail below:

Thorough comparison after the visual inspection of all the 216 samples and detailed discussion of print sharpness, transparency and feel of the burn out effects twenty eight samples were selected for inclusion in the final survey. The distribution of the preferred twenty eight samples is given in figure 1

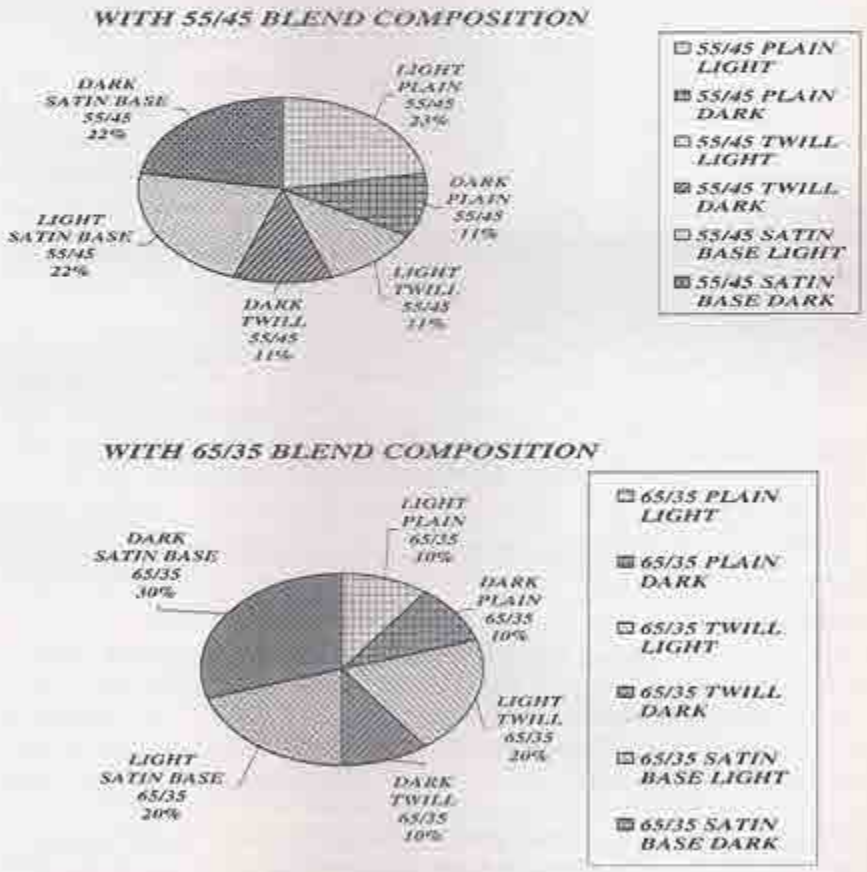

Figure 1. Distribution of preferred 28 samples with 55/45 blends and 65/35 blends.

The details of the twenty eight samples and their ratings for print sharpness, transparency, feel and overall appearance obtained in the survey are given in Table 4.

Table 4. Description of the Twenty Eight Samples and their Mean Ratings

SR. NO.	Blend Comp.*	Weave	Alkali Conc.	Drying Temp.	Drying Time	Print Sharp.	Trans.**	Feel	Over All App.***
1	55/45	Plain	5%	130°C	15mins	5	5	5	4.07
2	55/45	Satin	5%	130°C	10mins	5	1.42	3.57	1.42
3	55/45	Satin	5%	130°C	10mins	5	1.42	4.07	3.5
4	65/35	Satin	5%	130°C	10mins	3.57	1.78	3.57	5
5	55/45	Plain	10%	130°C	15mins	3.5	3.5	3.5	1.42
6	55/45	Satin	10%	130°C	15mins	5	1.78	5	4.07
7	55/45	Satin	10%	130°C	10mins	5	3.5	5	5
8	55/45	Plain	5%	160°C	15mins	5	5	4.07	1.42
9	55/45	Plain	5%	160°C	15mins	3.5	5	5	3.57
10	55/45	Twill	5%	160°C	15mins	3.28	3.57	5	1.42
11	55/45	Twill	5%	160°C	10mins	3.57	3.57	4.07	3.57
12	55/45	Satin	5%	160°C	15mins	5	1.42	5	3.28
13	55/45	Satin	5%	160°C	10mins	5	1.42	5	3.57
14	65/35	Twill	5%	160°C	15mins	5	1.42	5	3.57
15	65/35	Satin	5%	160°C	10mins	3.5	1.42	4.07	3.5
16	65/35	Satin	5%	160°C	10mins	3.5	1.42	5	5
17	55/45	Plain	10%	160°C	10mins	5	5	5	4.07
18	55/45	Plain	10%	160°C	10mins	5	3.5	5	4.07
19	55/45	Twill	10%	160°C	10mins	5	5	5	3.28
20	55/45	Twill	10%	160°C	10mins	5	1.78	5	5
21	55/45	Satin	10%	160°C	15mins	5	1.42	5	5
22	55/45	Satin	10%	160°C	10mins	4.07	1.42	5	5
23	65/35	Plain	10%	160°C	10mins	5	4.07	3.57	4.07
24	65/35	Plain	10%	160°C	15mins	5	3.5	5	3.5
25	65/35	Twill	10%	160°C	10mins	5	3.28	5	3.28
26	65/35	Twill	10%	160°C	10mins	3.28	3.5	5	3.57
27	65/35	Satin	10%	160°C	10mins	3.5	1.42	5	5
28	65/35	Satin	10%	160°C	15mins	5	1.42	5	4.07

*Blend comp- blend composition; **trans- transparency;
***over all app.- overall appearance

Results of samples printed with 5% Alkali concentration & Dried at 130°C (Samples 1-4)

Amongst the different weaves within 55/45 blends, plain weave was more preferred due to optimum print sharpness, transparency and feel in comparison to other weaves. Samples with satin base weave were also preferred due to optimum print sharpness and luster however, they were less transparent than plain weave. Twill weave in comparison produced less effective prints, which may be attributed to its compact construction.

Amongst the different weaves within 65/35 blends, satin base weave samples produced optimum prints in comparison to the plain and twill weave samples which may be due to the luster produced by the satin base weave structures.

On comparing the samples on the basis of the color of fabric, it was observed that plain weave with light color in 55/45 blend; satin weave with light color in 55/45 blend and satin weave with dark color in 65/35 blend were more preferred. (Refer Figure 2)

Results of samples printed with 10% Alkali concentration & Dried at 130°C (Samples 5-7)
Amongst the different weaves within 55/45 blends, plain weave was preferred due to optimum print sharpness, transparency and feel in comparison to twill weaves. Samples with satin base weave were also preferred due to optimum print sharpness and luster however, they were less transparent than plain weave. Twill weave in comparison produced less effective prints, which may be attributed to its compact construction.
Amongst the different weaves within 65/35 blends, satin base weave samples produced optimum prints in comparison to the plain and twill weave samples which may be due to the luster produced by the satin base weave structures.
On comparing the samples on the basis of the color of fabric, it was observed that plain and satin base weave with light color in 55/45 blend, and satin base weave with dark color in 65/35 blend were more preferred. (Refer Figure 2)

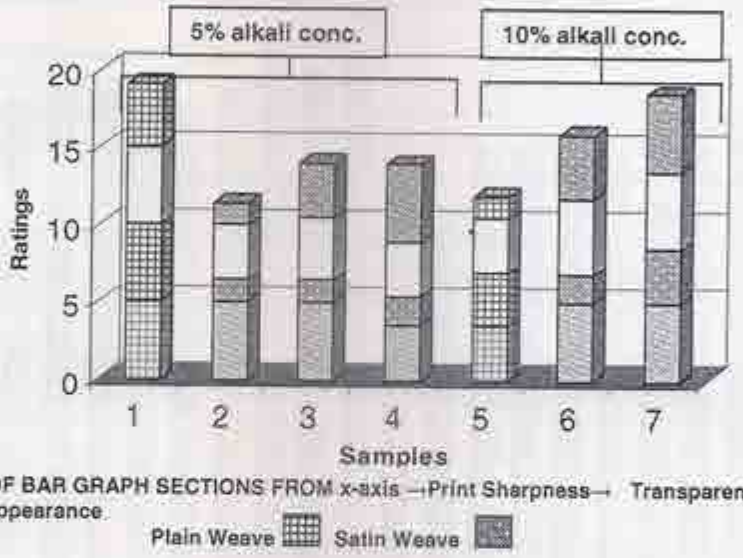

Figure 2. Samples with 5% and 10% alkali concentration dried at 130°C.

Results of samples printed with 5% Alkali concentration & Dried at 160°C (Samples 8-16)
Amongst the different weaves within 55/45 blends, the samples of plain, twill and satin base weaves were almost equally preferred. Plain and twill weaves were more preferred due to optimum print sharpness, transparency and feel in comparison to satin base weaves. However, satin base weave were more preferred due to optimum print sharpness and luster, but they were less transparent than plain weave. Twill weave was less preferred due to its compact construction.
Amongst the different weaves within 65/35 blends, satin base weave samples produced optimum prints in comparison to the plain and twill weave samples which may be due to the luster produced by the satin base weave structures. On comparing the samples on the basis of the color of fabric, it was observed that 55/45 blends with plain, twill and satin base weaves with both light and dark colors and 65/35 blends with twill weave light color and satin base weave with both light and dark colors were more preferred. (Refer Figure 3)

Results of samples printed with 10% Alkali concentration & Dried at 160°C (Samples 17-28)
Amongst the different weaves within 55/45 and 65/35 blends, plain weave was more preferred due to optimum print sharpness, transparency and feel in comparison to other weaves. Samples with satin base weave were less preferred to plain weave due to less transparency. Twill weave produced better transparency and print sharpness but was less preferred which may be attributed to its compact construction than plain and satin base.
Across all the samples within this group, it was observed that within 55/45 blends, plain, twill and satin base weaves with both light and dark colors and 65/35 with plain, twill and satin base weave with light color and plain and satin base weave with both light and dark colors with blend were more preferred. (Refer Figure 3)

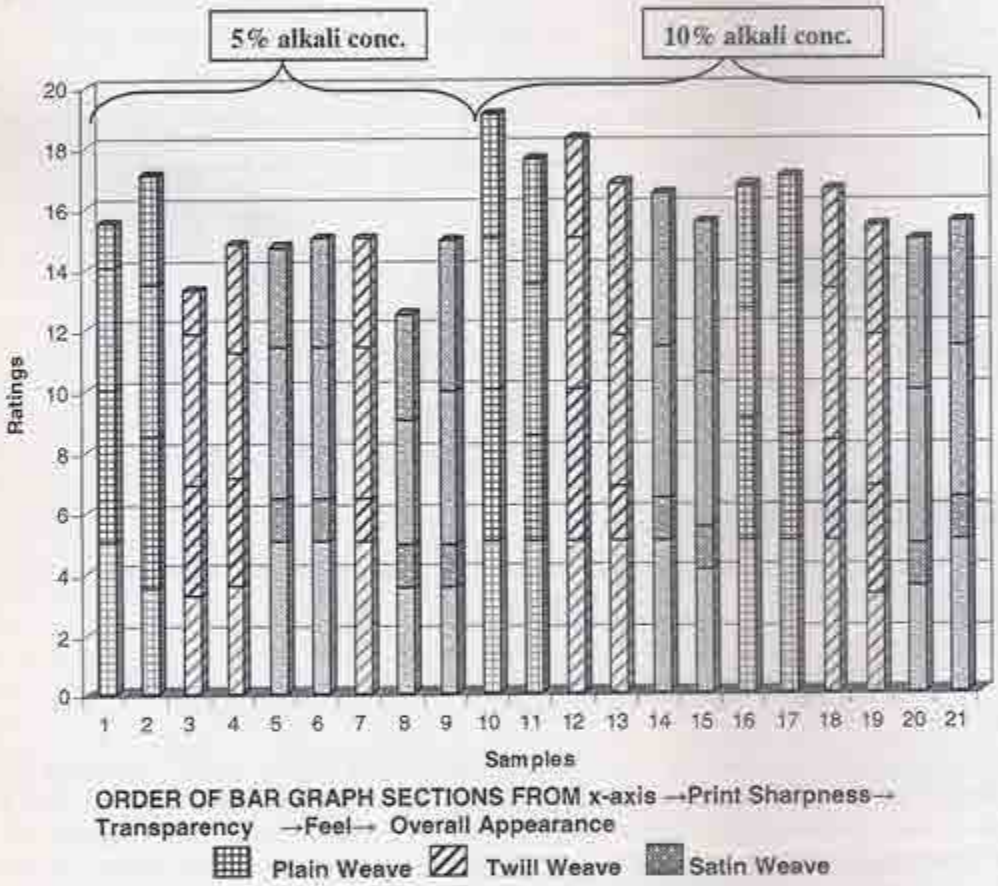

Figure 3. Samples with 5% and 10% alkali concentration dried at 160°C.

Role of the three criteria influencing the preference of Twenty-Eight Samples
From the figure 4 it is clear that the feel of the fabric was more pertinent than print sharpness and least was the criterion of transparency in influencing the preference of the samples. This result has come to surface mainly because 42% of 55/45 blends and 50% of the 65/35 blends amongst the preferred 28 samples were satin base weaves as the striking feature of satin base weave is the feel of the fabric and low transparency. The print sharpness is the next important criterion on priority that influences the preference of certain samples over the others. (Refer Figure 4)

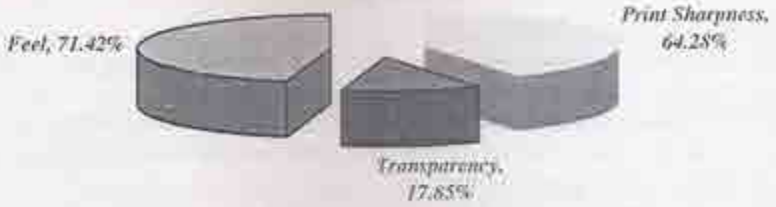

Figure 4. Ratings given in Percentages to the Twenty Eight Samples

Limitations and Recommendations

There is a marked influence of the blend compositions and the weave of the fabric on the burnt-out effects therefore; different other varieties of fabrics may be explored. Due to time factor the present study was done on available light and dark colored samples. Un-dyed grey fabrics were not available in the blend compositions and across weaves. The study had to be limited to neutral shades of beige, green, blue, black classified as light and dark colors. Different color combinations in polyester/wool; blends can be explored for doing burnout printing. Since the weave has marked influence on the print sharpness, transparency and feel of the fabric, burnout printing on other weaves like pile and sheer fabrics may also be explored.

Screen-printing was manual, control on force and movement of squeegee was limited. Also accident in smearing of paste may have caused defective prints. Therefore, burnout printing may be more effective in automatic printing machine.

The feel of some of the samples after burnout printing was harsh and hence a softening treatment may be recommended.

In order to achieve a combination of colored transparent prints, pigments may be added to the burnout print paste however; they need to be compatible with the burnout reagents.

Indalca gum may be functioning as an agent that binds the paste that contains polybinder, glycerine and caustic soda. The role of Indalca gum in the burnout print paste and in enhancing the print sharpness needs to be clarified.

Caustic fumes were released when printed samples were dried in an oven at 100°C, 130°C and 160°C for 5, 10 and 15 minutes. The source or cause of the fumes released may be studied further.

Variation in burnout effects may be observed due to the time method and procedure of rubbing and washing. Therefore, thorough washing mechanisms and standard procedures for burnout prints need to be standardized.

The solution turns brown when the printed samples were washed in hot soap solution. Thus, further research may be to evaluate the discoloration of the washing liquor.

At 160°C, prints on satin base weaves produce browning. Studies may be done to reason out the cause of this browning effect and bring some solution to avoid browning of satin base weave.

There is no print assessment test for burnout printing. Thus, a test for assessing the burnout prints needs to be devised.

SUMMARY AND CONCLUSIONS

The study was conducted to investigate the possibility of burnout printing and to standardize the procedure with optimum conditions producing effective burnout prints. Burnout printing was done on 55/45 and 65/35 blend compositions, with plain; twill and satin base weave structure of light and dark colors. Alkali concentration of 5% and 10% on the weight of print paste, drying temperature of 100° C, 130° C and 160° C and drying time of 5, 10 and 15 minutes were the conditions varied. On comparisons of all the printed samples, the conclusions drawn and explained are in the following sequence:

Composition of Blend: 55/45 blends are more preferred over the 65/35 blend composition. The reason may be that, in the former case, the percentage of wool is 45, whereas, in the latter blend composition, the wool content is 35 percent.

Weave of the Fabric: Plain and satin base weave is more preferred over twill weave. The reason may be the weave structure being open in case of plain weave. Satin base weaves are also preferred as they produce some luster in the printed area after the sample is washed.

Color of the Fabric: The burnout effects were more visible in light colored fabrics than on dark ones, when the printed samples were dried at 130°C of drying temperature across the different blend compositions (55/45 and 65/35). Amongst the printed samples that were dried at 160°C for 5, 10 and 15 minutes the print sharpness, transparency and feel were prominent irrespective of varying the time. However, they are less preferred, the reason being attributed to the color of the fabric.

Concentration of Alkali in Print Paste: When printed samples were dried at 130°C and 160°C, it was observed that both 5% and 10% concentration of alkali showed optimum print effectiveness.

Drying Temperature: Printed samples dried at 160°C were more preferred across both the concentrations than those dried at 130°C.

Duration of Drying: The samples which were dried for 10 minutes and 15 minutes were more preferred over those dried for 5 minutes.

Thus in conclusion, the effectiveness of the burnout print is an interplay of different variables of the fabric characteristics (blends of 55/45 and 65/35, plain, twill and satin base weaves and light and dark colors) and the process conditions for printing (5% and 10% alkali concentration, 130°C and 160°C of drying temperature and 5, 10 and 15 minutes of drying time).

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DYEING OF SILK FABRIC WITH INDIAN LABURNUM AND SHOE FLOWER USING NATURAL MORDANTS

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Neglected for having a comparatively low market, especially due to lack of standardization, fastness properties and short array of colours, natural dyes have had a tough time proving their benefits. Rejuvenating the ancient art of using natural dyes for textiles by not only exploring various new avenues but also by tapping ways and means to improve them is the need of the hour. The following study had been coined to broaden the scope of natural dyes using floral extracts of Indian laburnum and shoe flower along with natural mordants on Tussar silk. The mordants were used in combination - Indian gooseberry: pomegranate rind, Indian gooseberry: tamarind and pomegranate rind: tamarind in ratio of 1:3, 1:1 and 3:1. Pre mordanting, simultaneous mordanting and post mordanting techniques were employed across combination ratios. The dyes produced shades of beige and brown. The dye uptake was better while using the post mordanting technique in both the dyes. The results exhibited by both the dyes were good to excellent for their fastness properties to washing, rubbing, light and perspiration, irrespective of the mordant combinations used.

KEY WORDS: Tussar silk, natural dyes, Indian laburnum, shoe flower, natural mordants, Indian gooseberry, pomegranate rind and tamarind (seed kernel)

Natural dye extraction from plants and animals sources was quite prevalent until the discovery of synthetic dyes in 1956 by W.H. Perkin. Synthetic dyes became more prevalent as the raw materials required were easily available and cheap. (Agarwal & Gupta, 2003) Synthetic dyestuff and chemicals are preferred for dyeing textiles as their process of application is simplified, easy to standardize and they result in great variety of shades. But at the same time they have been proved to be hazardous. Thus, the interest in natural dyes has been revived due to its non-toxic environment friendly nature and due to emergence of eco-standards. (Singh Jeet, et. al. 2003) Though there are many studies conducted on natural dyes most have the use of synthetic mordants. Natural fibres such as silk are biodegradable and eco-friendly. When they are dyed using synthetic mordants, it affects their properties. Thus, the following study deals with dyeing of silk with floral extracts of Indian laburnum and shoeflower and using natural mordants like Indian gooseberry, tamarind, pomegranate rind.

MATERIALS AND METHODS

Tussar silk fabric was used in this study along with Indian laburnum (*Amaltas*) and shoeflower (*Jaswand*) as dye source and Indian gooseberry (*Anola / Amla*), pomegranate rind (*Anar*) and tamarind (seed kernel) (*Imli*) as natural mordants. The fabric was first degummed using Sunlight soap (10% owf), Soda ash (5% owf), TRO (1gm/lt). The fabric was impregnated into the warm soap solution (MLR 1:40) and treated for 1 hour at 90°C. The fabric was washed and dried. Then the fabric was bleached in 35% hydrogen peroxide (20 ml/lt) for 45 minutes at 80° C. The fabric was washed and dried. Subsequent to this it was pretreated with 20% owf Harda powder (MLR 1: 20) at room temperature for 30 minutes. The fabric was thoroughly squeezed and dried. The samples were then dyed using 20% owf dye powder (MLR 1:40). This process continued for 1 hour, subsequent to which the samples were rinsed in cold water and dried

The mordants (20% owf) were used in combination - Indian gooseberry: pomegranate, Indian gooseberry: tamarind and pomegranate: tamarind in ratios of 1:3, 1:1 and 3:1. Three mordanting techniques were employed – pre mordanting, simultaneous mordanting and post mordanting across the three ratios. The samples were then tested for their dye uptake and fastness property. Testing methods used were as follows:

- Maximum absorbance values were determined using spectrophotometer [Model: spectroscan – 5100 RT spectrophotometer] and computer having colour matching software packaging, consisting of CSLI QC – Quality assurance packaging CSLI, MAT – Formulation package, colour-on-screen, Formulation-on-screen. (Thomas, 2000)
- Colour fastness to washing: IS: 3361 – 1979 as in ISI Handbook of Textile Testing
- Colour fastness to rubbing: IS: 766 – 1956 as in ISI Handbook of Textile Testing
- Colour fastness to perspiration: IS: 971 – 1956 as in ISI Handbook of Textile Testing
- Colour fastness to light (sunlight): IS: 686 – 1957 as in ISI Handbook of Textile Testing

Grey scale was used to evaluate the samples for their colour fastness to the above elements.

RESULT AND DISCUSSION

Table No.1 Dye uptake values of samples dyed using Indian laburnum

Mordant	Ratio	Method	K/S	L*	a*	b*	C*	H*
		Standard	1.15	80.834	-1.004	18.361	18.388	93.165
C 1 Indian Gooseberry : Pomegranate Rind	1:3	Pre	6.16	64.312	1.987	24.819	24.898	85.388
		Simultaneous	7.68	65.604	2.202	27.136	27.225	85.326
		Post	8.60	65.272	1.961	27.915	27.984	85.947
	1:1	Pre	5.99	64.879	1.991	24.900	24.979	85.394
		Simultaneous	7.26	65.703	2.803	27.218	27.362	84.086
		Post	7.49	65.530	1.643	26.752	26.802	86.451
	3:1	Pre	5.35	64.998	2.202	24.374	24.473	84.804
		Simultaneous	7.24	63.756	3.151	25.976	26.166	83.050
		Post	6.23	65.605	1.882	25.101	25.171	85.678
C 2 Indian Gooseberry : Tamarind	1:3	Pre	3.14	69.267	1.766	21.827	21.898	85.34
		Simultaneous	3.59	69.986	2.505	23.325	23.459	83.836
		Post	2.75	72.079	1.516	21.176	21.230	85.871
	1:1	Pre	3.22	69.123	1.337	21.645	21.686	86.431
		Simultaneous	3.97	67.612	3.007	23.097	23.292	82.549
		Post	2.71	70.823	1.612	20.163	20.227	85.395
	3:1	Pre	3.76	66.321	2.265	21.829	21.946	84.042
		Simultaneous	5.09	64.439	3.561	23.821	24.086	81.465
		Post	3.30	68.610	1.896	20.947	21.033	84.794
C 3 Pomegranate rind: Tamarind	1:3	Pre	3.38	68.572	2.487	22.542	22.679	83.670
		Simultaneous	3.50	72.435	1.450	24.720	24.762	86.608
		Post	4.03	69.519	1.173	23.879	23.908	87.153
	1:1	Pre	4.10	67.300	2.254	23.443	23.551	84.474
		Simultaneous	4.13	72.153	1.229	25.722	25.751	87.229
		Post	5.39	69.577	1.403	26.346	26.383	86.917
	3:1	Pre	4.63	66.117	2.325	23.954	24.067	84.422
		Simultaneous	5.11	71.484	1.117	27.332	27.355	87.624
		Post	6.72	67.157	1.775	26.908	26.966	86.191

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Evaluation of samples dyed using Indian laburnum

1. The sample post mordanted using Indian gooseberry - pomegranate rind (1:3) exhibited higher depth in colour (k/s 8.60) as compared to other mordanting techniques.

2. In samples dyed using Indian gooseberry - pomegranate rind (1:1) combination it was observed that post mordanting method gave higher depth in colour (k/s 7.49) as compared to other mordanting techniques.

3. The samples simultaneously mordanted using Indian gooseberry - pomegranate rind (3:1) showed higher depth in colour (k/s 7.24) when compared with other mordanting techniques.

4. Depth in colour was observed higher (k/s 3.59) among the samples dyed using Indian gooseberry - tamarind (1:3) combination when dyed using simultaneous mordanting method.

5. Samples that were simultaneously mordanted using Indian gooseberry - tamarind (1:1) combination showed higher depth in colour (k/s 3.97) as compared to other mordanting techniques.

6. In sample dyed using Indian gooseberry - tamarind (3:1) it was observed that simultaneous mordanting method gave higher depth in colour (k/s 5.09) as compared to other mordanting techniques.

7. The sample dyed using pomegranate rind - tamarind (1:3) combination show higher depth in colour (k/s 4.03) when post mordanted as compared to other mordanting techniques.

8. The sample post mordanted using pomegranate rind - tamarind (1:1) combination exhibited good depth in colour (k/s 5.39) among other mordanting techniques.

9. Samples that were post mordanted using pomegranate rind - tamarind (3:1) combination showed higher depth in colour (k/s 6.72) as compared to other mordanting techniques.

Table No.2 Dye uptake values of samples dyed using Shoeflower

Mordant	Ratio	Method	K/S	L*	a*	b*	C*	H*
		Standard	1.15	80.834	-1.004	18.361	18.388	93.165
C 1	1:3	Pre	7.07	62.737	1.851	24.126	24.197	85.578
		Simultaneous	8.01	65.938	2.224	26.703	26.795	85.205
		Post	8.36	64.865	1.745	27.138	27.194	86.286
	1:1	Pre	6.78	63.49	1.870	23.851	23.924	85.483
		Simultaneous	6.36	66.876	1.792	24.711	24.776	85.818
		Post	7.03	65.602	1.399	25.521	25.559	86.827
	3:1	Pre	6.09	63.725	2.101	23.635	23.728	84.886
		Simultaneous	5.73	65.859	2.488	23.471	23.602	83.915
		Post	6.56	64.174	1.782	24.190	24.256	85.752
C 2	1:3	Pre	3.41	68.843	1.833	20.766	20.847	84.921
		Simultaneous	3.05	71.375	1.718	20.491	20.563	85.173
		Post	7.69	66.283	1.518	26.600	26.643	86.699
	1:1	Pre	3.77	67.679	1.985	21.125	21.218	84.598
		Simultaneous	3.85	68.330	2.435	21.215	21.354	83.419
		Post	6.54	65.659	1.341	24.868	24.904	86.878
	3:1	Pre	4.28	65.162	2.288	20.465	20.593	83.587
		Simultaneous	3.93	66.684	2.514	20.163	20.319	82.859
		Post	6.40	64.544	1.730	24.035	24.097	85.848
C 3	1:3	Pre	3.71	68.154	2.509	21.758	21.902	83.388
		Simultaneous	4.11	70.900	1.584	23.749	23.802	86.149
		Post	4.26	69.440	1.568	23.931	23.982	86.217
	1:1	Pre	4.47	67.419	2.161	22.945	23.047	84.586
		Simultaneous	4.84	69.855	1.415	24.294	24.335	86.632
		Post	6.34	66.850	1.562	25.747	25.794	86.493
	3:1	Pre	5.59	66.083	2.506	24.715	24.842	84.176
		Simultaneous	7.00	68.267	1.530	27.289	27.332	86.756
		Post	6.89	65.999	1.880	26.120	26.188	85.849

C 1- Indian Gooseberry: Pomegranate rind
C 2- Indian Gooseberry: Tamarind
C 3- Pomegranate rind: Tamarind

Evaluation of samples dyed using Shoeflower

1. The samples dyed using Indian gooseberry - pomegranate rind (1:3) combination exhibited higher depth in colour (k/s 8.36) when post mordanted as compared to other mordanting techniques.

2. Samples that were post mordanted using Indian gooseberry - pomegranate rind (1:1) showed higher depth in colour (k/s 7.03) as compared to other mordanting methods.

3. The samples post mordanted using Indian gooseberry - pomegranate rind (3:1) combination exhibited higher depth in colour (k/s 6.56) when compared with other mordanting techniques.

4. Depth in colour was observed higher (k/s 7.69) on sample that was post mordanted using Indian gooseberry - tamarind (1:3) combination as compared with other mordanting techniques.

5. Samples that were post mordanted using Indian gooseberry - tamarind (1:1) combination showed higher depth in colour (k/s 6.54) as compared to other mordanting methods.

6. The sample that was dyed using Indian gooseberry - tamarind (3:1) exhibited higher depth in colour (k/s 6.40) on post mordanting as compared to other mordanting methods.

7. In samples that were dyed using pomegranate rind - tamarind (1:3) combination higher depth in colour (k/s 4.26) was observed when post mordanted as compared to other mordanting techniques.

8. Depth of colour was observed higher (k/s 6.34) on sample that was post mordanted using pomegranate rind - tamarind (1:1) combination as compared with other mordanting techniques.

9. Samples that were simultaneously mordanted using pomegranate rind - tamarind (3:1) combination showed higher depth in colour (k/s 7.00) as compared to other mordanting methods.

WASHING FASTNESS

Evaluation of samples dyed using Indian laburnum

- All samples exhibited excellent wash fastness properties
- The mordants used, Indian gooseberry: pomegranate, Indian gooseberry: tamarind and pomegranate: tamarind, exhibited similar results.
- With respect to the mordanting methods the results were excellent
- The samples did not show any staining on the adjacent fabrics.
- With respect to the change in colour, the samples showed no change.

Evaluation of samples dyed using Shoeflower

- All samples exhibited excellent wash fastness properties
- The mordants used, Indian gooseberry: pomegranate, Indian gooseberry: tamarind and pomegranate: tamarind, exhibited similar results.
- With respect to the mordanting methods the results were excellent
- The samples did not show any staining on the adjacent fabrics.
- With respect to the change in colour, the samples showed no change.

RUBBING FASTNESS

Table No.3 Rubbing fastness ratings of samples dyed using Indian laburnum & Shoeflower

			Indian laburnum				Shoeflower			
Mordant	Ratio	Method	Warp		Weft		Wrap		Weft	
			Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
C 1	1:3	Pre	5	4/5	5	4/5	5	4/5	5	4/5
		Simultaneous	5	4/5	5	4/5	5	4/5	5	4/5
		Post	5	4/5	5	4/5	5	4	5	4
	1:1	Pre	5	4/5	5	4/5	5	4/5	5	4/5
		Simultaneous	5	4/5	5	4/5	5	4/5	5	4/5
		Post	5	4/5	5	4	5	4/5	5	4/5
	3:1	Pre	5	4/5	5	4/5	5	4/5	5	4/5
		Simultaneous	5	4/5	5	4/5	5	4/5	5	4/5
		Post	5	4/5	5	4/5	5	4/5	5	4
C 2	1:3	Pre	5	4/5	5	4/5	5	4/5	5	4/5
		Simultaneous	5	4/5	5	4/5	5	4/5	5	4/5
		Post	5	4/5	5	4/5	5	4	5	4
	1:1	Pre	5	4/5	5	4/5	5	4/5	5	4/5
		Simultaneous	5	4/5	5	4/5	5	4/5	5	4/5
		Post	5	4/5	5	4/5	5	4/5	5	4
	3:1	Pre	5	4/5	5	4/5	5	4/5	5	4/5
		Simultaneous	5	4/5	5	4/5	5	4/5	5	4/5
		Post	5	4/5	5	4/5	5	4/5	5	4/5
C 3	1:3	Pre	5	4/5	5	4/5	5	4/5	5	4/5
		Simultaneous	5	4/5	5	4/5	5	4/5	5	4/5
		Post	5	4/5	5	4/5	5	4/5	5	4/5
	1:1	Pre	5	4/5	5	4/5	5	4/5	5	4/5
		Simultaneous	5	4/5	5	4/5	5	4/5	5	4/5
		Post	5	4/5	5	4/5	5	4/5	5	4/5
	3:1	Pre	5	4/5	5	4/5	5	4/5	5	4/5
		Simultaneous	5	4/5	5	4/5	5	4/5	5	4/5
		Post	5	4/5	5	4/5	5	4/5	5	4/5

C 1- Indian Gooseberry: Pomegranate rind
C 2- Indian Gooseberry: Tamarind
C 3- Pomegranate rind: Tamarind

Evaluation of samples dyed using Indian laburnum

- All samples exhibited excellent rubbing fastness properties.
- With respect to the various mordant combinations used, all samples exhibited excellent dry rubbing fastness and good wet rubbing fastness.
- Rubbing fastness property with respect to the mordanting techniques used were similar, except in the case of Indian gooseberry: pomegranate rind (1:1) post mordanting showed slight staining (rating-4)

Evaluation of samples dyed using Shoeflower

- All samples exhibited good to excellent rubbing fastness properties.
- With respect to the various mordant combinations used, the samples showed excellent dry rubbing fastness and good wet rubbing fastness.
- The samples exhibited similar results with respect to the various mordanting techniques, except in the case of post mordanting techniques applied on Indian gooseberry: pomegranate (1:3) and (3:1). Also, Indian gooseberry: tamarind (1:3) and (1:1). The ratings are 4.

PERSPIRATION FASTNESS

Evaluation of samples dyed using Indian laburnum

- Perspiration fastness of all the samples was excellent to acid solution as well as alkaline solution.
- With respect to the mordants used excellent results were obtained.
- The samples exhibited excellent fastness properties with respect to the mordanting methods.
- The samples did not show any staining on the adjacent fabrics.
- With respect to the change in colour, the samples showed no change

Evaluation of samples dyed using Shoeflower

- Perspiration fastness of all the samples was excellent to acid solution as well as alkaline solution.
- With respect to the mordants used excellent results were obtained.
- The samples exhibited excellent fastness properties with respect to the mordanting methods.
- The samples did not show any staining on the adjacent fabrics.
- With respect to the change in colour, the samples showed no change.

LIGHT FASTNESS

Table No.4: Light fastness rating of samples dyed using Indian laburnum& Shoeflower

			Indian laburnum	*Shoeflower*
MORDANT	RATIO	METHOD	COLOUR CHANGE	COLOUR CHANGE
C 1	1:3	PRE	4 - 5	4
		SIMULTANEOUS	4 - 5	4 - 5
		POST	4 - 5	4 - 5
	1:1	PRE	4 - 5	4 - 5
		SIMULTANEOUS	4 - 5	4 - 5
		POST	4 - 5	4
	3:1	PRE	4 - 5	4 - 5
		SIMULTANEOUS	4 - 5	4 - 5
		POST	4 - 5	4 - 5
C 2	1:3	PRE	4 - 5	4 - 5
		SIMULTANEOUS	4 - 5	4 - 5
		POST	4 - 5	4
	1:1	PRE	4 - 5	4 - 5
		SIMULTANEOUS	4 - 5	4 - 5
		POST	4 - 5	4
	3:1	PRE	4 - 5	4 - 5
		SIMULTANEOUS	4 - 5	4 - 5
		POST	4 - 5	4 - 5
C 3	1:3	PRE	4 - 5	4 - 5
		SIMULTANEOUS	4 - 5	4 - 5
		POST	4 - 5	4 - 5
	1:1	PRE	4 - 5	4 - 5
		SIMULTANEOUS	4 - 5	4 - 5
		POST	4 - 5	4 - 5
	3:1	PRE	4 - 5	4 - 5
		SIMULTANEOUS	4 - 5	4 - 5
		POST	4 - 5	4 - 5

C 1- Indian Gooseberry: Pomegranate rind
C 2- Indian Gooseberry: Tamarind
C 3- Pomegranate rind: Tamarind

Evaluation of samples dyed using Indian laburnum

- The samples exhibited good results with respect to the dye used.
- The results were good across all mordant combinations (rating – 4 / 5)
- The samples showed good light fastness properties with respect to the various mordanting techniques used.

Evaluation of samples dyed using Shoeflower

- With respect to the dye use the samples showed good results.
- Among the samples dyed with the various mordant combinations Pomegranate: tamarind showed over all good light fastness.
- The samples exhibited good light fastness properties with respect to the various mordanting techniques except for pre mordanting on Indian gooseberry: pomegranate rind (1:3) and post mordanting on Indian gooseberry: pomegranate rind (1:1), Indian gooseberry: tamarind (1:3) and Indian gooseberry: tamarind (1:1), rating 4.

SUMMARY AND CONCLUSION

In the present study tussar silk fabric was dyed using two natural dyes (Indian laburnum and shoeflower) along with natural mordants. The mordants were used in combination - Indian gooseberry: pomegranate rind, Indian gooseberry: tamarind and pomegranate rind: tamarind in ratio of 1:3, 1:1 and 3:1. Pre mordanting, simultaneous mordanting and post mordanting techniques were employed across combination ratios. The dyes produced shades of beige and brown.

The dyed samples were evaluated on the basis of their dye uptake and fastness properties to light, perspiration, rubbing and washing. The following conclusions were drawn on the basis of the results obtained.

INDIAN LABURNUM

- The samples gave better dye uptake on post mordanting as compared to other mordanting techniques. Post mordanting technique enhanced the substantivity of the dye on the fabric.
- With respect to the mordant combination used the wash fastness and perspiration fastness properties were found to be excellent for all combinations while light fastness and rubbing fastness properties were found to be good.
- All three mordanting methods exhibited improved fastness properties.

SHOEFLOWER

- The samples gave better dye uptake on post mordanting as compared to other mordanting techniques. The substantivity of the dye on the fabric was enhanced by post mordanting technique.
- With respect to the mordant combination used the wash fastness and perspiration fastness properties were found to be excellent for all combinations while light fastness properties were found to be good and rubbing fastness properties were found to be fair.
- All three mordanting methods exhibited good fastness properties.

On the basis of the results obtained it can be concluded that these dyed samples can be put to various use in apparel and furnishings. Also, further studies can be conducted in the field of natural dyes using natural mordants in combination to enhance the fastness properties of the dyed textile.

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EVALUATION OF RISK FACTORS ASSOCIATED WITH WORK - RELATED MUSCULOSKELETAL DISORDERS AMONG BEAUTICIANS

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The work of beauticians consists of repetitive actions/postures and long hours of standing which may lead to major MSD in the long term. A study was therefore carried out to evaluate the risk factors associated with work-related Musculo-skeletal disorders (WRMSD's) in a sample of 100 beauticians' (50) each from Mumbai and Vadodora city respectively. The assessment of postures in beauty parlor while performing the activities was done using Rapid Upper Limb Assessment (RULA) and Ovaku Work posture Assessment Sheet (OWAS). The results of RULA amongst the beauticians indicate the presence of higher stress on upper arm, lower arm and wrist than on neck, trunk and legs. OWAS revealed that there is not much deviation of the beauticians' posture from the normal posture. Thus, to improve the posture minor engineering changes like trolley should be introduced to the workers. The study concluded that RULA and OWAS methods can be considered as useful methods for evaluation of risk factors associated with WRMSDs.

KEY WORDS: Ergonomics, musculoskeletal disorders, RULA, OWAS, Risk factors.

An important aspect that Indian women just cannot choose to ignore today is the overwhelming number of beauties our county is throwing up at international pageants. Beauty culture has been the right hand of the glamour industry. Today in India beauty industry offers jobs in small towns and older city areas. This is because even the ordinary housewife wants to look good for her family and herself. Beauty lies in what we portray and how we project ourselves. For decades women have worked hard at keeping their exteriors beautiful. It is a well-known fact that stress and the rigors of daily life can affect the end result. The work carried out in a beauty parlor frequently requires leaning over to look after customers who are lying on a massage table or an aesthetic chair for facial or body treatment. The job consists of repetitive work, eight hours a day. Major risks involved are cervical or back disorders due to leaning. Major ergonomic problems are backache and / or pulling a muscle due to poor posture, eyestrain due to extended concentration and neck pain. There may also be problems with veins because of extended periods of standing. Another problem arises because the beauticians often work in dark and windowless rooms (with no opening to the outside) and because the working hours are frequently long and variable, and breaks are not fixed.

Hairdressers, beauticians, massage workers, washing and ironing workers, cashiers, paging operators all have to make a lot of repetitive movements with their hands and forearms. This can easily cause upper limb Musculo-skeletal disorders. Work related Musculo skeletal Disorders (WRMSDs) are common, and tenosynovitis of hand and forearm results when one exerts. Upper limb MSDs includes discomfort, pain, muscle soreness, cramp, numbness and tenderness in the shoulder, elbow, forearm, wrist and fingers. The symptoms may not affect ones' daily activity or work, but if they persist and remain untreated, they will gradually deteriorate and develop occupational diseases.

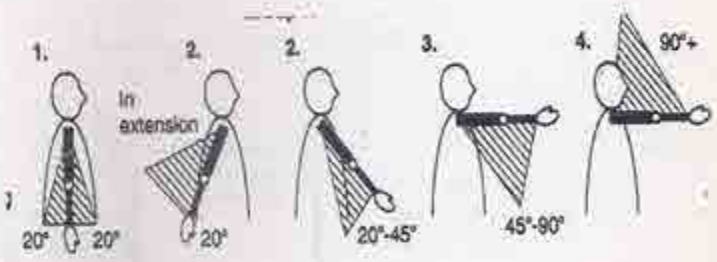
METHODOLOGY

For the present study 50 (each) respondents were purposively selected from cities i.e. Mumbai and Vadodara. A structured interview schedule was framed to collect the information regarding background and specific information of the beauticians. The RULA method uses diagrams of body postures and the three scoring tables to provide evaluation of exposure to risk factors. The risk factors under investigation were described as external load factors. These factors include number of movements; static muscle, work; force; work postures determined by the equipments and furniture. In RULA method, the body is divided into segments, which formed two groups of A (includes the upper and lower arm and wrist) and B (includes the neck, trunk and legs). The range of movement for each body part is divided into sections according to criteria derived through interpretation of relevant literature. These sections are numbered so that the number one is given to the range of movement or working posture where the risk factors present is minimal. Higher numbers are allocated to parts of the movement range with more extreme postures indicating and increasing presence of risk factors causing load on the structures of the body segment.

RULA is a survey method developed for use in ergonomic investigations for work related upper limb disorders (McAtamney and Corlett, 1993). RULA is a screening tool that assesses biomechanical and postural loading on the whole body with particular attention to the neck, trunk and upper limbs (McAtamney and Corlett, 1993). Reliability studies have been conducted using RULA on groups of VDU (visual display unit) users and sewing machine operators (McAtamney and Corlett, 1993). A RULA assessment requires little time to complete and the scoring generates an action list (table 2), which indicates the level of intervention required to reduce the risks of injury due to physical loading on the operator (McAtamney and Corlett, 1993). RULA is intended to be used as part of a broader ergonomic study

Upper Arm

Add 1 if shoulder is raised
Add 1 if upper arm is abducted
Subtract 1 if leaning or supporting the weight of the arm



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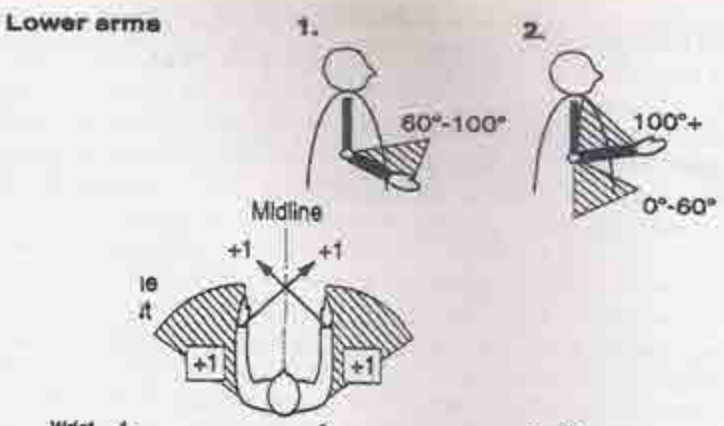
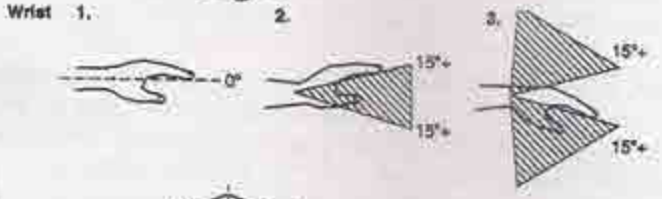
Lower Arm
Add 1 if working across the midline of the body or out of the side

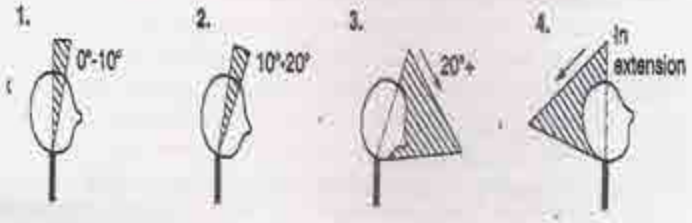


Wrist
Add 1 if wrist is bend away from the midline

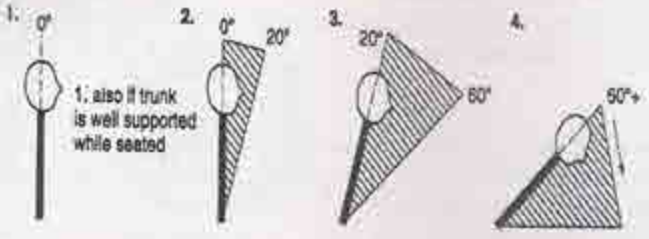


RULA: Wrist twist
1. Mainly in mid range of twist
2. At or near end of the twisting range

Neck
Add 1 if neck is twisting
Add 1 if neck is side bending



Trunk
Add 1 if trunk is twisting
Add 1 if trunk is side bending



RULA: Legs

1. Leg and fit are well supported and in an evenly balanced postur
2. Legs and feet are NOT well supported or NOT in an evenly balanced posture

RULA: Muscle use Score

Raise the score by 1 if the posture is
- Mainly static, e.g. held for longer than 1 minute
- Repeated more than 4 times per minute

RULA: FORCE or LOAD Score

0. No resistance or less than 5 lb (2 kg) intermittent load force
1. 5-20 lb (2-10 kg) intermittent load force
2. 5-20 lb (2-10 kg) static or repeated load force
3. More than 20 lb (10 kg) static or repeated loads or forces. Shock or forces with rapid build-up

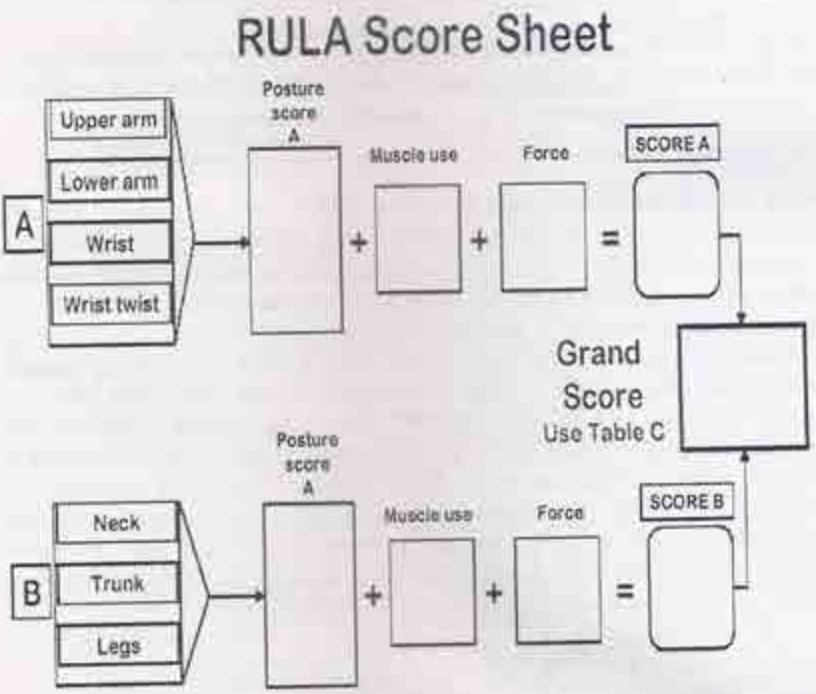


Table C: Grand Score Table

TABLE C		SCORE D (NECK, TRUNK, LEG)						
		1	2	3	4	5	6	7+
SCORE C (UPPER LIMB)	1	1	2	3	3	4	5	5
	2	2	2	3	4	4	5	5
	3	3	3	3	4	4	5	6
	4	3	3	3	4	5	6	6
	5	4	4	4	5	6	7	7
	6	4	4	5	6	6	7	7
	7	5	5	6	6	7	7	7
	8+	5	5	6	7	7	7	7

Action Level

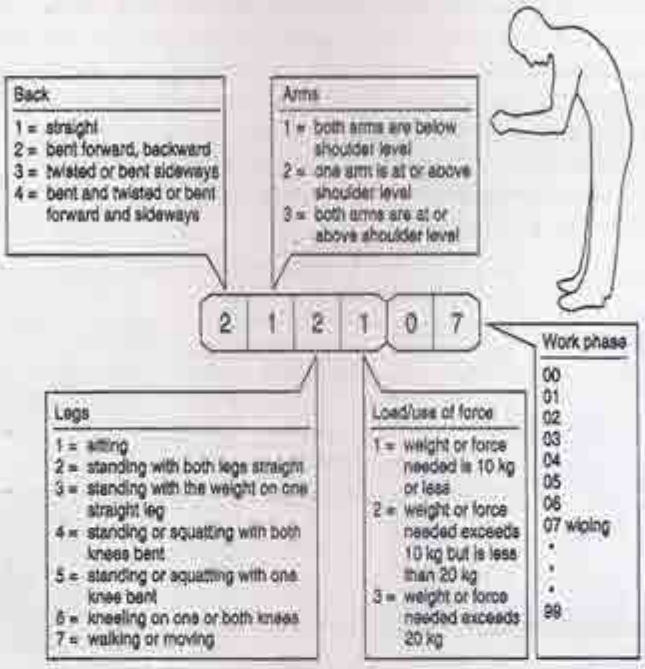
•Action level 1- a score of 1 or 2 indicates that posture is acceptable if it is not maintained or repeated for long periods
•Action level 2- a score of 3 or 4 indicates that further investigation is needed and changes may be required
•Action level 3- a score of 5 or 6 indicates that investigation and changes are required soon
•Action level 4- a score of 7 indicates that investigation and changes are required immediately

OWAS

The Ovako Working Posture analysis system has been widely used to identify and evaluate harmful working postures (Karhu, et al, 1977). OWAS codes the working postures with its 84 standard posture combinations: 4 back, 3 arm and 7 leg postures. The system reveals the frequency and relative proportion of time spent in specific postures and assessments by a four-level scale of harmfulness of postures with the urgency to correct such postures.
OWAS has shown convergent validity when compared to other posture recording techniques such as Rapid Entire Body Assessment (REBA) (McAtamney and Hignett 2000). The inter-observer reliability of OWAS is excellent, with Karhu et al. (1977) measuring a median reliability of 93%. Direct observation and video observation have both been validated for the use of OWAS (Long, 1993). Videotaping and posture analysis (OWAS) from a monitor have been validated in other studies too (Scott and Lambe, 1996). The advantage of using videotapes is that the observer can have a much longer time to look at the observed posture. The videotape can also easily and effectively be used in recalling the actual work situations when providing feedback from the posture study.

OWAS Worksheet

Achieving at Grand Score to identify the Action Level



a)

Back	Arms	1			2			3			4			5			6			7			Legs
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	Use of force
1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	3	1	1	1	1	1	1	1	1	1	2	2	3	2	2	3	1	1	1	1	1	2	
2	1	2	2	3	2	2	3	2	2	3	3	3	3	3	3	3	2	2	2	2	3	3	
	2	2	2	3	2	2	3	2	3	3	3	4	4	3	4	4	3	3	4	2	3	4	
	3	3	3	4	2	2	3	3	3	3	4	4	4	4	4	4	4	4	4	2	3	4	
3	1	1	1	1	1	1	1	1	2	3	3	4	4	4	1	1	1	1	1	1			
	2	2	2	3	1	1	1	1	2	4	4	4	4	4	3	3	3	1	1	1			
	3	2	2	3	1	1	1	2	3	4	4	4	4	4	4	4	4	1	1	1			
4	1	2	3	3	2	2	3	2	2	3	4	4	4	4	4	4	4	4	4	2	3	4	
	2	3	3	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	
	3	4	4	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	

Action categories
1 no corrective measures
2 corrective measures in the near future
3 corrective measures as soon as possible
4 corrective measures immediately

Force Use:
1= </= 10 Kg
2= 10 – 20 Kg
3= > 20 Kg

RESULTS AND DISCUSSIONS

In this study, a Rapid Upper Limb Assessment (RULA) was selected for use as a quick and systematic objective assessment of the posture, forces and activities undertaken by the beauticians. RULA is a tool that assesses biomechanical and postural loading on the whole body with particular attention to the neck, trunk and upper limbs and also a survey method developed for use in ergonomic investigations of workplaces where work related upper limb disorders are reported. Furthermore, RULA assessment requires little time to complete and the scoring generates an action level, which indicates the level of intervention required to reduce the risks of injury due to physical loading while performing different tasks. Although, the experience of the observer plays an important role in postural analysis, using RULA by untrained people in ergonomics can also provide accurate, rapid initial assessments of jobs that may result in upper limb disorders.

Table I: Personal details of the Beauticians

	Age (in year)		
	Range (Age)	Mean	S.D.
Mumbai	18-44	21.8	3.41
Vadodara	17-64	30.5	6.95

Table 1 depicts that respondents from Mumbai were in the age range of 18-44 years and the mean age was 21.8 years. In Vadodara the age range was 17-64 years with the mean age of 30.5 years.

Table II: Statistical analysis of the RULA body part score (Mean and S.D.) and the reported pain, ache or discomfort of the region.

	Group 'A'			Group 'B'		
Body Region	Upper - arm	Lower - arm	Wrist-Twist	Neck	Trunk	Leg
Mean	2.20	1.58	2.20	1.88	1.70	1.11
S.D.	1.18	0.60	0.84	0.83	0.71	0.31

The result of this study showed that the RULA body scores in-group **'A'** was higher than that in-group **'B'** for majority of the beauticians. The Mean of the Upper arm and Lower arm was 2.20 and 1.58 respectively and Deviation from the normal curve was 11° and 9° respectively. Whereas Mean of the Trunk was 1.70 and deviation from the normal curve was 7°.

Table III. Statistical analysis of the OWAS body part score (Mean and S.D.) and the reported pain, ache or discomfort of the region.

Body Region	Back	Arms	Legs
Mean	1.9	1.5	2.1
S.D.	0.9	0.3	0.4

Table 3 reveals that there was not much deviation of the beauticians' posture from the normal posture.

In order to improve the posture minor engineering changes like trolley should be introduced to the workers.

RULA and OWAS method could be considered as a useful method for the evaluation of risk factors associated with WRMSDs as investigated by previous researchers.
Following are the common postures adopted by the beauticians while working.

ACKNOWLEDGEMENT

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ASSESSMENT OF INDOOR RESIDENTIAL HAZARDS AND OCCURRENCE OF ACCIDENTS AMONGST THE ELDERLY IN VALLABH VIDYANAGAR – A COMPARATIVE STUDY OF ELDERLY MEN AND WOMEN

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Common causes of death and injury among older people appears to be accidents at home which can be easily avoided. Hence the objective of the study was to gain an insight into the perceived sense of safety of elderly women and men and occurrence of accidents in the existing indoor environment in five selected areas of their residential units namely, entrance, living room, kitchen, bathroom, and staircase. 50 women and 50 men above the age of 60 years, residing in Vidya Nagar town were interviewed for occurrence of domestic accidents. The data revealed that 60 percent elderly women and 54 percent elderly men had accidents in the house. The highest percentage of accidents took place in the bathroom and kitchen for women, and for men it was bathroom and the entrance of the house. The study concluded that as the age increases the perceived sense of safety decreases. Safety suggestions were provided to enhance safety at home.

KEY WORDS: Indoor environment hazards; Elderly people; Sense of safety; Frequency of occurrence of accidents.

The official projections of the Registrar General, India, in 2001 estimated 71 million as the elderly population, and predicted it to be 114 million by the year 2016.The change in the age structure is evident from the fact that all through the last four decades, the growth rate of the 60+ populations has been consistently higher than that of the total population. (Barber, 2000)

The numbers of deaths caused by accidents have fallen by 37 per cent across all age groups (in Ireland) over the past twenty years. Fall continues to be a relatively common cause of death and injury among older people often resulting in serious long-term difficulties and even premature death. Consequently the reduction of accidents in the older population is considered to be an important factor in promoting the general well being of older people.

The Swiss architect Le Corbusier suggested that a house is "a machine for living in." Like any machine, it can be dangerous, either if the machinery itself goes wrong or if it is wrongly operated. Every year thousands of fatal accidents happen in our homes, and these are far outnumbered by the accidents that cause much suffering even though they do not result in death.

The home can be made a safer place to live in by thoughtful design of both, the house or flat and the items we use in it. Safety is important for all individuals, more so for the old who may be more susceptible to risk. The elderly are at risk because of their failing powers, they are less quick to respond to a dangerous situation and are not able to react as appropriately as younger people can. The major cause of concern is the accidents, which occur in the house.

Only in the last decade accidents inside the home have begun to be treated as seriously as accidents outside the home. The present study was undertaken with a view to throw some light on

the exiting indoor environmental hazards in the house of elderly people. The most dangerous part of the house is the floor in living room, bedrooms and hallways.

The present research encompasses five accident-prone areas in the house of elderly namely; kitchen, entrance, living room, bathroom and staircase. The concern was to probe into research questions like; what is the perceived sense of safety of the elderly women under the existing indoor environmental conditions of their homes. What is the nature and frequency of accidents that occur amongst the elderly women and men in their homes?

The present study was thus an attempt to fill the lacunae in regard to researches on indoor environmental hazards in the houses of elderly.

The specific objectives of the study were

1) To study base line characteristics and demographic characteristics of the respondents.
2) To study reasons for accidents amongst the elderly people in their houses.
3) To assess the nature and the frequency of occurrence of accidents amongst the elderly people in their house.
4) To correlate the perceived sense of safety amongst elderly women and men with age.

DELIMITATIONS:

The study is limited to -

1) 50 elderly women and 50 men who are 60 years or above of Vidya Nagar town.
2) Only graduate and above respondent s were selected as a sample.
3) Five areas of the houses namely entrance, living room, kitchen, bathroom, and staircase were selected.

MATERIALS AND METHODS:

The sample for the present investigation constituted of 50 elderly women and 50 elderly men who were 60 years and above. Snowball sampling technique was opted as the mode for selecting the sample. Interview schedule was selected as a tool for collecting the data. Detailed information pertinent to base line characteristics of respondents and their homes, occurrence of domestic accidents and their perceived sense of safety were gathered. The data was analyzed statistically by using frequencies, percentages and co-efficient of correlation for the present study. The prime objective of the study was to gain insight into the perceived sense of safety of elderly women and men and occurrence of accidents in the existing indoor environment in the five selected areas of their residential units namely; entrance, living room, kitchen, bathroom, and staircase. An interview schedule was used to build up the data for the present study. The objectives drawn for the study guided the development of an appropriate interview schedule, having three distinct sections. Section one comprised of information pertaining to baseline characteristics and health conditions of the respondents, and details regarding their house in terms of occupancy, type and tenure. Section two of the questionnaire dealt with the routine indoor activities carried out by the elderly women, focusing upon the type, duration of the activities, specific area where the activities are performed and so on. This section also enabled the researchers to elicit data on occurrence of domestic accidents among the elderly women and men in the five selected areas of their houses, during a reference periods of two years; with regard to types of accidents, location and cause, and injury occurred. A standardized scale to assess the perceived sense of safety of the elderly women and men in the exiting indoor environment in the five selected areas of their residential units constituted the third section of the questionnaire.

RESULTS AND DISCUSSION:

Keeping in mind the major objectives of the study, analysis of the data was done and results are discussed.

TABLE 1 : AGE OF RESPONDENTS

Age (Years)	Men		Women		Total	
	n	%	n	%	n	%
60-64	23	46	21	42	44	44
65-69	21	42	18	36	39	39
>70	06	12	11	22	17	17
Total	50	100.00	50	100.00	100	100.00
Mean	65		66			
S.D	3.50		3.80			

Table.1 shows age of respondents. Regardless of the sex of the respondents 44 per cent respondents were between 60 to 64 years; 39 per cent of the respondents fall in the 2nd category i.e., 65 to 69 years age group and only 17 per cent respondents were above 70 years old.

TABLE 2 : REGULARITY IN HEALTH CHECK-UP

Regularity in health check-up	Men		Women		Total	
	n	%	n	%	n	%
Regular	29	58	37	74	66	66
Irregular	21	42	13	26	34	34
Total	50	100.00	50	100.00	100	100.00

Table 2 shows the regularity in health check-up. Regularity in medical check-up is indicative of the health status of an individual and it would have a noticeable impact on people. About 58 per cent of the elderly men and 74 per cent of the elderly women in the present study reported being regular with their medical check-up. However, 42 per cent of men and 26 percent of women did not go for any medical check-up at all or were not regular in their health check-up.

TABLE 3 : NUMBER OF HEALTH- RELATED PROBLEMS AMONGST THE ELDERLY PEOPLE

Number of health related problems	Men		Women		Total	
	n	%	n	%	n	%
1-3	14	28	10	20	24	24
4-6	25	50	31	62	56	56
<7	11	22	09	18	20	20
Total	50	100.00	50	100.00	100	100.00

Table 3 shows number of health related problems amongst the elderly people. The data revealed that 28 percent men and 20 percent elderly women in the present study had 1 to 3 health related problems, while about 50 percent men and 62 percent women faced 4 to 6 health related problems. Further, more than 6 health-related problems were observed in case of 22 percent men & 18 percent women.

TABLE 4: TYPES OF HOUSE

Types of House	Men		Women		Total	
	n	%	n	%	n	%
Flat	12	24	12	24	24	24
Tenement	15	30	11	22	26	26
Bungalow	22	44	18	36	40	40
Duplex	1	2	9	18	10	10
Total	**50**	**100.00**	**50**	**100.00**	**100**	**100.00**

Table 4 shows types of houses the respondents lived in. Regardless of the sex of the respondents, it was observed that majority (44% and 36% of men and women respectively) of them occupied bungalows, nearly one – third of the respondent's occupied flats and tenements and only 10 percent of them occupied duplex.

TABLE 5 : TYPE OF ACCIDENTS THAT OCCURRED

Type of accidents	n (women)	%	n (men)	%
Bathroom				
Slipping	02	04	03	06
Falling from commode	01	02	04	08
Colliding with door	03	06	02	04
Electric Shock	06	12	03	06
Total	**12**	**24**	**12**	**24**
Living room				
Colliding with furniture	02	04	01	02
Scratch/Cut	-	-	01	02
Falling from Bed, Sofa or Diwan	01	02	01	02
Slipping	01	02	-	-
Falling	01	02	02	04
Total	**05**	**10**	**05**	**10**
Kitchen				
Slipping	02	04	01	02
Falling	01	02	01	02
Electric shock	05	10	02	04
Colliding with door/Furniture	01	02	-	-
Total	**09**	**18**	**04**	**08**
Entrance				
Falling from steps	01	02	02	04
Slipping	02	04	03	06
Falling	01	02	01	02
Total	**04**	**08**	**06**	**12**
Total number of accidents	**30**	**60**	**27**	**54**

Table 5 shows type of accidents that occurred amongst the elderly people in their home. For 24 percent women and 24 percent men the accidents took place in the bathroom, which could be another dangerous area in the house, due to wet or slippery floor of the bathroom. Further, it was observed that 2 percent women & 8 percent men fell from commode, colliding with tap and had electric shock.

It was found that 10 percent women and 10 percent men had accidents due to colliding with furniture in the living room; the reason for the same being improper furniture placement and low light levels in the living room. Slipping, falling from bed / divan / sofa, were the other kinds of accidents that were reported to have occurred in the living room.

Among 2 percent of women and 4 percent of men, accidents took place by falling from the stairs/step.

TABLE 6: REASONS FOR ACCIDENTS

Reasons of accidents	n (women)	%	n (men)	%
Wet Floor	07	14	10	20
Low light level	05	10	06	12
Improper furniture arrangement	02	04	01	02
Slippery floor/glossy surface	03	06	04	08
High height of steps	03	06	03	06
Imbalance / weakness / absent mindedness / height of furniture	02	04	-	-
Improper placement of tap	01	02	-	-
Uneven floor level	03	06	-	-
Improper railing	01	02	01	02
Leg entangled in carpet	01	02	-	-
Tension/stress	-	-	-	-
Obstruction in view	-	-	-	-
Due to curtain	-	-	01	02
Reason not specified	02	04	01	02
Total	**30**	**60**	**27**	**54**

Table 6 shows the reason for the accidents.
It was found that 60 percent elderly woman and 54 percent elderly men in the five-selected areas of their house had accidents. About 50 percent accidents occurred due to either low light levels or wet floor & improper furniture arrangement. Slippery / glossy floors and improper height of the stairs / steps were also reported as cause of accidents by 6 percent women and 8 percent men and 6 percent women and men of the respondents respectively. The other reasons for accident, revealed by the elderly women and elderly men, were improper placement of tap and uneven floor-level.

TABLE 7 : CONSEQUENCES OF ACCIDENTS

Consequences of accidents	n (women)	%	n (men)	%
Pain in abdomen / back / legs / hands	09	18	13	26
Dislocation / crack / fracture in spinal- cord / head / legs / hands	04	08	03	06
Cut / wounds / bruises / burns	06	12	04	08
Swelling in hands / legs / other body parts / sprain	05	10	03	06
Not reported	06	12	04	08
Total	**30**	**60**	**27**	**54**

Table 7 shows consequence of accidents. It was found that 18 percent women and 26 per cent men suffered from pain in abdomen, back, legs and hands; and 8 percent women and 6 percent men reported that they suffered from dislocation, crack or fracture in spinal cord, head, legs and hands due to various domestic accidents that took place.

Different indoor accidents also resulted in cuts, wounds, bruises and burns in 12 percent women and 8 percent men whereas, 10 percent women and 6 percent men had swelling in hands, legs and other body parts and only a few per cent women respondents experienced sprain due to accidents.

The data also shows that 12 percent women and 8 percent men did not report any type of consequences even though they had met with domestic accidents in the selected areas of their homes.

TABLE. 8: PERCEIVED SENSE OF SAFETY IN THE HOME AMONGST THE RESPONDENTS

Sr. no.	Perceived sense of safety (Score range)	Women		Men	
		n	%	n	%
1.	Poor (109-195)	0	0	0	0
2.	Fair (196-282)	6	12	3	6
3.	Good (>283)	44	88	47	94
	Total	**50**	**100.0**	**50**	**100.0**
	Mean	**279**		**280.07**	
	S.D.	**12.59**		**57.84**	

Table 8 shows perceived sense of safety in the entire home. In the present study it was found that about 88 percent of the elderly women and 94 percent of the elderly men had good sense of safety in the entire home. About 12 percent of the elderly women and 6 percent of the elderly men had fair sense of safety in the entire home. The mean and S.D. for the perceived sense of safety in the entire home was computed for women and men respectively to be 279, 12.59 and 280.07, 57.84 respectively.

TABLE. 9: Co-Efficient Of Correlation Between Age Groups Of Elderly Women And Sense Of Safety In Various Area Of The Home:

Age groups (in years)	Overall safety	Entrance safety	Kitchen safety	Living Room safety	Bathroom safety	Staircase safety
60-64	0.10	0.19	0.07	0.20	0.01	0.39**
65-69	0.05	0.27	0.02	0.40*	0.07	0.32*
>70	0.59**	0.13	0.71**	0.47**	0.08	0.06

**Significant at 0.01 level *significant at 0.05 level

Table 9 shows co-efficient of correlation between different age groups of elderly women and their sense of safety in various areas of the home. The correlation is calculated at 0.01 level and at 0.05 level of significance. Table 9 revealed that the age groups between 60-64 years did not show any significant correlation between various areas of home and sense of safety except in the stair- case (r =0.39 significant at 0.01 level). The elderly women between the age ranges 65-69 years showed significant correlation between sense of safety in living room and staircase (r= 0.40 and 0.32 respectively at 0.05 significant level). The eldest group of women who were more than 70 years of age showed that overall safety (r = 0.59), kitchen safety (r = 0.71) and living room safety (r = 0.47) was significant at 0.01 level.
Thus it could be concluded that as the age increase the feeling of safety decreases and there is relationship between age and feeling of safety in the home.

Table. 10: Co-Efficient Of Correlation Between Age Groups Of Elderly Men And Sense Of Safety In Various Area Of The Home:

Age groups (in years)	Overall safety	Entrance safety	Kitchen safety	Living Room safety	Bathroom safety	Stair case safety
60-64	0.07	0.31	0.20	0	0.08	0.20
65-69	0.08	0.35	0.05	0.80	0.40	0.90
>70	0.23	0.55**	0.82**	0.59**	0.67**	0.42*

**Significant at 0.01 level *significant at 0.05 level

Table 10 shows co-efficient of correlation between different age groups of elderly men and their sense of safety in various areas of the home. The correlation is calculated at 0.01 level and at 0.05 level of significance. Table 10 revealed that the age groups between 60-64 years and 65-69 years did not show any significant correlation between various areas of home and sense of safety. In the eldest group of men who were more than 70 years of age showed that entrance safety (r =0.55), kitchen safety(r = 0.82) living room safety (r = 0.59), bathroom safety (r = 0.67) and stair case safety(r = 0.42) was observed respectively significant at 0.01 level and 0.05 level.
Thus it could be concluded that as the age increase the feeling of safety decreases and there is relationship between age and feeling of safety in the home.

SUMMARY AND CONCLUSION

The study was conducted to understand indoor environmental hazards in five selected areas of the residential units of the elderly namely; entrance, living room, kitchen, bathroom, and staircase.

The baseline characteristics of the elderly revealed that about 58 per cent of the elderly men and 74 per cent of the elderly women went regularly for their medical check-up.

The data also showed that 28 percent men and 20 percent elderly women had 1 to 3 health related problems, while about 50 percent men and 62 percent women faced 4 to 6 health related problems.

The elderly are prone to accidents at home because of their failing powers, and as they are less quick to respond to a dangerous situation than young adults. In this study, an attempt was made to throw some light on the domestic accidents and the study found that highest percent of accidents took place in the bathroom and kitchen for women and for men; it was bathroom and the entrance of the house.

The reasons for accidents were found to be wet floors and low level of light for both elderly men and women and primary consequences of the accidents were pain in the abdomen, hands, and legs.

The study also found a relationship between age and feeling of safety at home i.e. as the age increases the feeling of safety decreases in the elderly.

The reduction of accidents in the older population is therefore an important factor in promoting the general well being of older people and these are a few suggestions to enhance safety at home i.e.

- Write emergency numbers in the house at a visible place.
- Keep electrical cords along walls and away from traffic areas
- Keep stair cases in good condition and free from obstacles.
- Light switches should be located near the doors/entrances.

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3. Effect of irradiation on the nutritive and functional properties of kidney beans and black gram
   Jose Marina and Dias Nina

4. Effect of radiation processing on antioxidant activity, nutritional value, functional properties, sensory attributes and storage of Phaselous Vulgaris L
   Khamersa Arohi and Ibrahim Geeta

5. Effect of radiation processing on antioxidant activity, nutritional value, functional properties, sensory attributes and storage of Vicia fabah
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