Insecure food availability affects a large number of populations in most of the developing and underdeveloped countries. Therefore, chronic shortage of feeds for human beings has drawn the attention of nutrition workers to look for newer and unconventional food resources. The relevant information on the possibilities of using different unconventional food in human diets and their effects on rats as well as in case of human malnutrition have thoroughly reviewed under the following headings:

A. 01. STUDIES ON *COLOCASIA ESCULENTA*

*Colocasia esculenta* (L) Schott is an important tuber crop grown throughout the tropics and sub-tropics for its edible corm and cornel which are rich sources of carbohydrates, proteins, vitamins and minerals. It is believed to be originated in the Indo-Malayan region, probably in Eastern India (de la pane, 1970). *Colocasia* is known as old cocoyam, dasheen or eddoe in different parts of the world and locally known as ‘kachu’ under the monocotyledonous family ‘Araceae’. It is an important substitute crop in various parts of Papua, New Guinea, including the highest areas. Aroids make a significant contribution both as root crops and vegetables in the diets of people particularly in rural areas where they are freely available. Due to the palatability problems associated with its high content of oxalates in the form of raphides, the crop has not realized its full potential. (Sarma, 1997).

According to an estimate, *Colocasia esculenta* (L) Schott occupied an area of 0.98 million hectar with an annual production of 5.7 million tones of tuber (FAO,
1997). It is considered as an important crop in Caribbean, Hawaii, Solomons, American Samoa, Western Samoa, the Philippines, Fiji, Sri Lanka, India, Nigeria, Indonesia, New Guinea and Egypt (de la pana, 1970). *Colocasia esculenta* (L) Schott, according to Das et al (2004) is extensively grown throughout the humid tropics and used by people for its edible corms and leaves as well as for its traditional use.

The status of *Colocasia* is of significant importance in Assam, because it serves as a nurse crop in newly introduced coffee plantation in the districts of North Cachar, Karbi-Anglong and Nagaon. The tender leaves, Petiole and runners are considered as vegetables and because of its excellent storage quality it is considered as ideal crop to elevate the lean period of vegetable supply. *Colocasia* has great importance for its higher nutritive value, particularly carbohydrate, Protein, vitamin-c and minerals.

**A. 02. DIFFERENT VARIETIES OF COLOCASIA ESCULENTA**

Many different forms of this species are grown in different parts of North-Eastern region of India and are likely to differ in composition and nutritive value. According to Maurya (1977) there are two groups of *Colocasia* viz. eddoe and dasheen type which are grown in Assam. Different local varieties of this crop of varying yield potential are available.

Different varieties of *Colocasia esculenta* (L) Schott (dasheen) are locally known as – Tekeli Kachu, Borkachu, Mohkhuti, Ahina Kachu, Koni Kachu, Kaka...
Kachu, Sahasramukhi, Panchamukhi, Neel Kachu etc. Another variety of *Colocasia esculenta antiquorum* (L) Schott (eddoe) belongs to the family Araceae. All these varieties of *Colocasia esculenta* are grown in different areas and are likely to differ in productivity, composition and nutritive value. Yield and maturity of these groups of cocoyam vary depending on types, varieties, place, climatic condition, method of cultivation etc., (Bora, 1995).

Sahasramukhi variety of *Colocasia* was developed in Andhra Pradesh, which is recommended for all India cultivation. It is considered to be a very good yielder and the duration of cultivation completes in about 180 days. (Dutta, 1995). According to Bora (1995) the taste of “Ahina Kachu”, “Kaka Kachu” and “Neel Kachu” were very good, good and fair respectively. The cultivators “Ahina Kachu” and Neel Kachu” cooked well whereas “Kaka Kachu” did not cook well. All these cultivars were found non acrid in nature.

*Colocasia esculenta* Linn. or Swamp taro is one of the important tuber crop under the genus *Colocasia* belonging to the family Araceae (Baruah, 1999). It is a popular vegetable crop due to its high nutrition value, delicious taste and good flavour. All parts of this variety contain a good amount of carbohydrate, protein, minerals like calcium, phosphorus and iron (Milli, 2001). It is also known as “Panikachu” or “Nalkachu” in Assamese and Bengali language. The name of the crop itself indicates its ability to grow in low lying areas and under water logged condition.
India to South Eastern Asia is considered to be the origin of this crop. (Plucknett and de la pena, 1971). In Assam, its cultivation is popular in some pockets of the lower Brahmaputra valley. This type of *Colocasia* is cultivated extensively in countries like India, Bangladesh, and Malaysia. It is very useful crop in Bangladesh (Baruah, 1999).

*Xanthosoma (Xanthosoma sagittifolium)* L. Schott, belonging to the family Araceae is native to tropical South America and the Caribbean islands. It is also known as tannia and new cocoyam in different parts of the world. In Assam, it is most popularly known as ‘Boga Dohi’ (Sarma, 1998). *Xanthosoma* is widely cultivated throughout the tropics mainly in the West Indies, Puerto Rico, Cuba, Central and South America, Hawaii, West Africa, Tropical Asia and south East Asia. In India, *Xanthosoma* is usually grown in the states of West Bengal, Orissa, Kerala, Andhra Pradesh, Tamil Nadu, Maharastra, and especially in North Eastern States including Assam.

**A.03. GROWTH AND DEVELOPMENT OF COLOCASIA.**

Genotype, nutrition and plant density play an important role which determines the growth and productivity in a culture. Hundreds of cultivar is grown in different parts of Assam and adjoining states. Wide variation in stature and growing habit exist among the cultivars and are likely to influence in growth productivity, nutritive value, yield and maturity.
Mohan Kumar and Sadanandan (1990) reported that there are four distinct growth phases in *Colocasia* as - early establishment phase, early growth phase; grand growth phase and maturity phase, which last for 4-6 weeks, 6-13 weeks, 13-18 weeks and 19-23 weeks respectively after planting. Earlier, the general pattern of growth in *Colocasia* was studied by Ching (1970) and draw similar conclusions.

Igbokwe (1984) studied the growth and development of *Colocasia esculenta* at Umudike in 1980-81 and found that sprouting began at 2 weeks and reached 70-90% after four weeks after planting. Most of the cultivars of *Colocasia* exhibited highest petiole length at 125 days after planting (Sarma, 1994). Throughout the life of the crop, there is a continual turnover of the leaves with the older ones drying as new ones appear (Onwueme, 1978).

Plucknett and de la pana (1971) revealed that rapid vegetative growth of *Colocasia* occurs during the first 4-6 months of growth which is marked by increase in leaf area, leaf number, weight and plant height. Purewal and Dargan (1957) reported that plant height and leaf area increased significantly by application of Potassium. The narrow spaced crop gives significantly smaller size of tubers which ultimately affected the yield of tubers (Mohan Kumar and Mandal, 1972).

According to Harshad (1956), Cocoyams are ready for harvesting when most of the leaves begin to turn yellow. Choudhury (1967) found that *Colocasia* can be harvested from about 3 months after planting, but matures in about 130-140 days. Anonymous (1985) reported that in *Colocasia*, duration varies depending upon cultivars maturity characteristics and growers need. The crop takes about 8-12
months from planting to maturity. Purseglove (1972) investigated the maturity
index of *Colocasia* and found that it usually matures in about 8-10 months after
planting. According to Baburam (1980), the time of harvesting of *Colocasia* varies
with variety and time of planting. Baruah (1982) reported that out of the local
cultivars of cocoyam viz- Koladohi, Ghee, Lasua, Zengoui, Tekeli, Koni, Mukhia,
Boga Ahina, Kola-Ahina and Kaka, the highest yield of 31-90 tons per hector was
recorded under Koni Kachu followed by Kaka Kachu with 30.25 tons per hector,
while the lowest was recorded under Mukhia Kachu (19.48 tons per hector). Leon
(1976) reported that vegetative propagation is unavoidable because its inefficiency
to set seed for natural and cultural factors. Das *et al* (1981) studied the performance
of some *Colocasia* cultivars and reported that the highest yield of cultivar
“Panchamukhi” was recorded (32.80 tons /hector) and lowest yield of “Tekeli
Kachu” (19.91 tons/hector).

A. 04. CHEMICAL COMPOSITION:

Chemical composition of cocoyam varies with species and variety. The
varietals differences may ultimately determine the nutritive value of a particular
crop (Barooah 1982). A study conducted by Changkakati (1992) revealed that the
chemical compositions of cocoyams are spares and whether there are significant
changes in composition among the varieties and different parts of the plant is also
uncertain. Choudhury and Hussain (1979) revealed that varietal differences and
climatic conditions are the main factors to affect the chemical composition of
cocoyam.
The most abundant single constituent of vegetable is water, which may represent up to about 96% of total weight. The moisture content is a measure of yield and quality of food solids. Clark (1985) reported that moisture content is not a fixed property and the moisture content usually influences the water activity and independently represents the yield and total solids.

According to Bora (1995), the moisture content of corms and cormels decreases gradually towards maturity. The chemical composition of cultivars varied significantly with the age. The highest moisture content of corm at harvest was exhibited by cultivars Kaka Kachu (65.07%) and the lowest was observed under Ahina Kachu (58.39%). It was observed that ascorbic acid, ash, calcium content and sugar acid ratio of the cultivars increased towards maturity.

Prabhakaran and Nair (1984) recorded maximum amount of dry matter for the crops planted in the month of April, while it was the lowest in the crop planted during the month of November. They have concluded that the amount of dry matter produced per plant decreased with delay in planting.

Anonymous (1985) studied the dry matter content of 10 *Colocasia* cultivars and highest dry matter content was recorded in the cultivars Sahasramukhi (27.0%), while the lowest was recorded in the cultivar white Gauria, (19.2%). Mohan Kumar and Sadanandan (1990) reported that the dry matter production in roots, petiole and leaf increases from 60-120 days after planting. However, beyond 120 days it declines. They also reported that in case of tuber, dry matter production starts at 3 months after planting and increases gradually up to harvesting. The dry matter content of corm and cormel of *colocasia* was found to increases towards maturity.
Agbor-Egbe, T and Richard, J.E. (1990) determined the chemical compositions of cormels of 24 cultivars of *Colocasia esculenta* var. *antiquorum* and 8 cultivars of *Xanthosoma Sagittifolium*. They obtained mean values for both the species in g/kg were ash 28.7-77.7 and total sugars 5.9 – 42.9. The main sugars identified by HPLC were fructose, glucose, sucrose and maltose. Leung et al (1972) reported 21.0 and 32.0 percent carbohydrate content in *Colocasia esculenta* and *Xanthosoma Sagittifolium* respectively.

The starch content of *Colocasia* remains low upto 16 weeks after planting, while sugars were high up to this time. Harshad et al (1956), Fasidi (1994) determined the carbohydrate content of corms and cormels of local white and pink *Colocasia esculenta* and found that they stored starch, glucose, fructose and sucrose. Of these carbohydrates, starch was the most abundant while glucose was the lowest.

Shanmugham (1973) studied 11 different varieties of *Colocasia esculenta* from Tamil Nadu and Kerala. He found out that - the amount of protein ranges between 19.25% to 15.75% in different varieties of *Colocasia esculenta*. There are many reports on the mineral composition of *Colocasia*, but results very regarding its mineral composition in different aroids grown in different places (Srivastava and Krishna, 1959; Gopalan et al, 1980). *Colocasia* contains oxalic acid in the form of calcium oxalate raphides, which is mainly responsible for undesirable irritation (Tang and Sakai, 1983). Oxalic acid content of *Colocasia* corms can be reduced to a certain extent by boiling the corms (Changkakati, 1992). In *Colocasia* major anti
nutrient factor is crystals of calcium oxalate. The acridity due to calcium oxalate is destroyed by cooking or fermentation (Lee, 1999).

A. 05. COLOCASIA ESCULENTA AS FOOD AND ITS MEDICINAL USES:

Colocasia is considered as a vegetable which has minor importance in some Asian Countries and as a staple food in many areas of pacific regions. Corms and cormels are generally consumed after boiling or currying or frying in oil. Occasionally, the petiole and tender leaves and the runners are used as vegetables (Sarma, 1994). “Fufu” and “Poi” are the two processed products prepared from Colocasia which are considered as popular dishes in West and East Africa. It is consumed as an emerging food in the time of famine and makes a good substitute for Irish potatoes (Solanum tubersum). The flour obtained from Colocasia corm can be mixed with wheat flour in the ratio of 1:3 (Jain et al, 1950).

Different varieties of Colocasia and Xanthosoma are extensively consumed as vegetables in Assam and in the North Eastern region. “Aneshi” is a traditional fermented food of Nagaland, made from the leaves of Colocasia esculenta (Das et al, 2004). Aneshi is used as an enhancer of food tastes and palatability. Fermented foods prepared from colocasia include “Sepal” (Gratid corm mixed with coconut milk) and “Poi” (corms peeled and ground to paste) which are popular in the south pacific.

The cultivar “Nalkachu”, (Colocasia esculenta) Linn. can be used as a very good source of vegetables for its very low acridity. All the plant parts of the crop
viz. corm, stolon, petiole, leaf etc., can be utilized for preparation of tasty dishes. Corms of the crop can be used in the same way as potato. The flesh is fibrous and posses a delicate nutty flavour when cooked. The corms are peeled, sliced and cooked with condiments and adjuncts. Chips can be prepared out of the freshly cut pieces of corm. Stolon of the crop can be used as fried vegetables as it has no acridity. Besides corm and stolon, immature leaves along with tender stalks are also cooked and used as vegetables. It is said that leaves which are just going to unfurled are tastier than other leaves (Baruah, 1999). A study conducted by Milli (2001) on Nalkachu revealed that -- it is available throughout the season and has a great scope for its commercial exploitation. They also provide raw material for convenience foods (flour), animal feeds and commodity chemicals like starch, vitamin-c, protein etc.

Cocoyams of *colocasia* are having great importance for its medicinal uses (Nadkarni, 1927). In ‘Otorrhoea’, the juice of petiole is dropped into the ears of children and the ash obtained from root stalk mixed with honey is a local application for ‘Apathae’ in mouth. In “rheumatism”, the hot tubers are applied to the painful parts. According to Sarma (1999) and Milli (2001), there is folklore that -- the juice of stem and leaves of Nalkachu could be used for treatment of constipation, colic pain and piles.

**B. 01. STUDIES ON ALOCASIA INDICA:**

*Alocasia indica* is a genus of broad leaved rhizomatous or bulbous perennials from the family Araceae. There are about 70 species of *Alocasia*
occurring in Asia, Oceania and South America (Hedrick, 1919). *Alocasia indica* is a tall aroid with an underground rhizome, bearing a succulent swollen stem, 4-8 inch in diameter. It is cultivated in Assam and Bengal as a food crop. It is also an ornamental plant. (The Wealth of India, 1948).

Dutta (1985) revealed that *Alocasia indica* (Roxb) Schott is a perennial erect, robust, herbaceous plant cultivated for its edible stem, leaf stalk as vegetables.

According to Radhakrishnan (2004), *Alocasia* or Elephant ear plant is large, evergreen, mainly rhizomous, sometime tuberous, rooted perennials. The plant, which belongs to the family Araceae is found in tropical forests and sunny opened or shaded; usually damp sites and marshes in South East Asia. Some spices of *Alocasia* are suitable for houseplants.

**B.02. STUDIES ON DIFFERENT VARIETIES OF ALOCASIA:**

Although about 70 spices of *Alocasia* occur in Asia, Oceania and South America, studies are available only to a few species only. Apart from this, no systematic study on bio-chemical analysis of *Alocasia* have not done so far. *Alocasia indica* Schott, Araideae Pai, is a variety of *Alocasia* grown in East Indies, South Asia, and South sea islands and in east Australia. The underground stems constitute a valuable and important vegetable of the native dietary in India. The native of the kingsmill group of islands cultivate this species with great care. The root is said to grow to a very large size (Hedrick, 1919).
Alocasia macrorrhiza Schott Ape Taro is another variety of Alocasia. It is mostly found in Tropics of Asia, Australia and the islands of the pacific. It is the taro of New Holland (Hedrick, 1919). According to Dutta (1985), Alocasia macrorrhiza (Schott), ‘Araceae’ which is known as ‘Bor Kachu’ in Assam is a perennial erect herbaceous plant, which is found in Sibsagar, Nagaon, Karbi-Anglong and Kamrup districts of Assam.

In another study by Roecklein (1987), revealed that Alocasia macrorrhiza (L.) G. Don is a variety of Alocasia, which grows like a shrub. This taro is native of India, Malaysia and Sri Lanka. This plant in the winter assumes a green colouring. It is large, stout rhizomatous herb, leaves broadly ovate, deeply cordate, apparently wild, and sometimes cultivated for its edible petiole (Goswami, 1993).

Alocasia Sanderiana - another variety of Alocasia is rhizomatous perennial with arrow shaped dark green leaves. Sometimes purple beneath, with deeply lobed silver margins, a metallic sheen and silver veins. Each leaf is about 30-40 cm long and the leaf stalks are about 50 cm long (Radhakrishnan, 2004).

B. 03. GROWTH AND DEVELOPMENT OF ALOCASIA:

The large sagittate leaves of Alocasia grow to a length of 20 to 90 cm on long petioles. Their beautiful araceous flowers grow at the end of short stalk, often hidden behind the leaf petioles. The root of Alocasia indica Schott, Araideae pai grows to a very large size (Hedrick, 1919).
*Alocasia macrorrhiza* (L.) G. Don is a large erect herb, grows up to 2-4 metre tall with thickened stems, and 20 cm in diameter. Leaves grow up to 1 metre in length. The root is matured after 400-600 days. (Roecklein, 1987).

According to Radhakrishnan (2004), *Alocasia indica* grows outdoors in moderately fertile, humus rich, moist but well drained soil in partial shade. *Alocasias* are cultivated for their heavily veined leaves.

**B. 04. ALOCASIA INDICA AS FOOD AND ITS MEDICINAL VALUE:**

*Alocasia indica* is being used as a food way back from 1919. Because of its long preservation period, they are of great importance in jail dietary, where fresh vegetables become scarce in the bazaar. In the Polynesian islands, its large tuberous roots are eaten. The root of *Alocasia macrorrhiza* Schott is eaten in India, after being cooked. The roots are also eaten in tropical America as well as by the people of New Caledonia (Hedrick, 1919).

The stem and root stocks of *Alocasia indica* are edible, if boiled and washed thoroughly. When the root stalk is pulped and washed, it yields a pure white starch. The flour obtained is a light nutritious food substitute for invalids. It is somewhat mucilaginous and is considered to be more easily digestible than rice (The Wealth of India, 1948).
Accordingly to Dutta (1985), the leaf stalk, stem and roots of *Alocasia indica* (Roxb) Schott are used as vegetable. The stem of *Alocasia macrorrhiza* (L.) G. Don is peeled and used as a cooked vegetable, being added to soups and stews. The corms should be thoroughly cooked before eating. A very easily digested starch or flour can be prepared from the stem (Roecklein, 1987). *Alocasia indica* (Roxb) Schott, Araceae is cooked as vegetables by Khasi, Jaintia and Garo tribes of Meghalaya (Kayong, 2007).

*Alocasia indica* and its different species also have medicinal value. It is found in a study that – the juice of the leaf of *Alocasia indica* is astringent. The rhizome is said to act as a mild laxative and diuretic and is considered useful in anasarea (The Wealth of India, 1948).

Dutta, (1985) revealed that – the juice of *Alocasia indica* (Roxb) Schott Araceae is astringent and rhizome is mild-laxative. In the same study it was observed that – the juice of the stem of *Alocasia macrorrhiza* (Schott) Araceae relieves scorpion and nettle sting. In Boro-Kachari community, a paste is prepared from the rhizome of *Alocasia macrorrhiza* (L.) G. Don (Araceae) and is applied to abscesses to expel pus (Goswami, 1994). According to Deorani and Sharma (2007) extract of leaves of *Alécasia macrorrhiza* (L.) G. Don (Araceae) is used in snake bite. The rhizome is used in treating colic, vomiting and Phelegmon. Its external use is as a plaster in effective furuncerlosis. In Indonesia, *Alocasia macrorrhiza* (L.) G. Don is used to cure scabies and kudies (Kulkarni & Ansari, 2004). According to Roy et al (2008), the leaves of *Alocasia indica* (Roxb) Schott, Araceae are used to cure rheumatism and constipation.
It is necessary to have some knowledge of the nutritive value of different unconventional foods for its proper use. Several workers (Ravindran et al., 1982; Dominguez, 1985; Garcia et al. 1991; Yadav, 1997) evaluated the chemical composition of banana leaves, *colocasia* and *cassava*. Various workers have reported that *colocasia* contains carbohydrate, protein and some micronutrients (Gohl, 1993; Baruah, 2002). Although *Alocasia indica* are available in different parts, yet its consumption is restricted among people of certain areas only. Apart from this, no systematic study on the nutrient composition of *Alocasia indica* is reported. The present investigation was conducted to study and evaluate some of the nutrient components of *Alocasia indica* and its utility in the treatment of malnutrition. The nutrient components in terms of moisture, ash content, crude fibre, crude protein, ether extract, minerals like calcium, phosphorus, iron, iodine and non-nutritive components like oxalic acid were determined using standard methods.

Generally, the nutritive value of a food depends upon its nutritional contents and their digestibility and on the presence or absence of antinutrients and toxin factors. Several workers have studied the nutritional quality of *colocasia* (Aggarwal *et al*, 1999; Awasthi and Tandon, 1987; Gupta *et al*, 1989).

Adda (*Bauhinia Vahilli*) and marketing nuts (*Semaiarpus ahacardium*) are consumed by the tribals of Andhra Pradesh are rich in fat, protein, iron and calcium (Ramasastri and Shenolikar, 1974). They also consume rajkura seeds which is a fair source of protein. (Rajalakshmi and Geervani, 1987)

According to Chitra and Chandrasekhar, (1988), the nutritive value of ‘Kurai’ and ‘Puliari’—two greens were well within the range of value reported by ICMR for the other commonly used greens.

Pushpalatha and Chandrasekhar (1988) reported that – ‘Bellara Khizhangu’ and ‘Kathu Kathari’ had higher calcium content and good amount of ascorbic acid respectively.

The tubers and leaves of *colocasia* (*colocasia esculenta*) contains Dry matter – 26.2% ; 8.2% ; Crude Protein – 8.7% , 25% ; Crude fibre – 1.7% , 12-17% ; Ether extract – 0.4%, 10.7% ; Ash-4.0%, 12.4% and Nitrogen free extract 85.2%, 39.8% respectively on dry matter basis (FAO, 1993).

Geethapriya et al (2000) reported that – Amaranthus whole plant contain crude protein – 15.28%, Ether Extract – 2.51%, Crude Fibre-19.06%, Nitrogen free Extract – 43.34% and total Ash 19.81% on dry matter basis.

Kauser and Parveen (2001), revealed that-*Spiruline*, a kind of blue green microalgae is rich natural sources of protein, carotenoids and other micronutrients.
It is the only source of vit-B₁₂ of plant origin and it has highly available form of iron.

The tender leaf, petiole and corm of *colocasia* contain 24.25%, 8.00% and 10.44% protein and rich in iron. The corm of taro is also considered as a good source of carbohydrate and potassium. Although taro corms are relatively poor source of ascorbic acid and carotene, carotene content is equivalent to that of cabbage and twice to that of potato (Baruah, 2002).

Babu (2000), revealed that *Moringa* (*Moringa Oleifera*) Lam. Moringaceae, a common tree in Malawi is one of the richest sources of vitamin-A and vitamin-C compared to the commonly consumed vegetable. Moringa is suggested as a potential solution to the problem of vitamin-A deficiency.

*Cucurbita maxima* Linn. flowers are a kind of food normally used by warli tribes of Maharashtra, which contains 22% protein; (Bhadane and Tekale, 2000).

Bora (1999) reported the chemical composition of banana stem as – Dry Matter – 20.26%; crude protein – 9.19%; Ether Extract – 2.36%; Crude Fibre -14.63%; Total Ash – 11.25%; calcium – 0.14%; phosphorus – 0.09% respectively. He also reported that sweet potato contains Dry matter – 44.76%; Crude Protein – 4.38%; Ether Extract – 4.49%; Crude Fibre – 0.89%; Total Ash – 4.27%; Calcium -0.18% and phosphorus -0.11% respectively.
According to Yadav and Gupta (1997), the tuber of *colocasia esculenta* contain Dry Matter – 34% ; crude protein 9.45% ; Ether Extract -0.67% ; Crude Fibre-5.70% ; Nitrogen free Extract – 77.48% and total Ash-6.07% respectively.

Madhavilatha *et al* (1999) studied the chemical composition of *Acacia Arabica* (Babul Pods) and revealed that – the crude protein, Ether Extract, Crude fibre, Nitrogen free extract, total ash contents in Babul pod was 13.16, 5.31, 20.65, 50.48, 6.06, 1.37 and 0.12 percent respectively on dry matter basis.

‘Gundruk’ and ‘Sinki’ are two kinds of traditional fermented food consumed by various ethnic communities in Manipur contains slightly higher amount of protein (91.65) and fats (0.54) than its fresh form (Lairenlakpam and Chhetry, 2004).

Senani, (2004) reported that – the taro leaves contains crude protein 7.18-10.5% ; crude fibre 21.35 – 23.7% ; ether extract-7.12-113% ; ash – 9.75 -10.5% ; nitrogen free extract – 33.7 – 44.0% ; calcium – 0.62 %and phosphorus – 0.33 – 0.35%. The tubers contained crude protein 6.9 -7.9% ; crude fibre-19.4-16.6% ; ether extract – 1.05-22.21% ; ash 9.25-10.9% ; nitrogen free extract-62.0 – 62.5% ; calcium 1.60 – 1.66% and phosphorus 0.55 – 0.60 % on dry matter basis.

A popular traditional food of the eastern Himalayan region is the ‘Kinema’. It is nothing more than fermented soybeans, but is a good source of vitamins and minerals. It is the cheapest source of protein in the region. (Atreya, 2005).
Mazumdar (2006) studied the nutritive value of eri-pupae and observed that eri-pupae has highest percentage of crude protein (59.4%) and soluble protein (54.25%), substantial quantity of dietary lipid (25%), crude fibre (5.85%), calcium (0.15%), phosphorus (0.61%) and iron (0.04%).

According to Kowsalya and crassina (2008), lotus stem (Nelumbium Nelumbo) has highest iron content. Janagi and Lakshmi (2008) reported that banana powder contains protein – 0.5-1.5 g; fat – 0.5 – 3.5 g and carbohydrate 60-80 g per 100 gm. Gulkari et al (2008) studied the nutritive value of leaves, pods and seeds of Vigna Capensis Walp (Jungli Mung, wild cowpea) and revealed that the carbohydrate content ranged from 59.81-74.03%, protein content is highest in seeds (21.68%) and lowest in leaves 3.4%.

D. USE OF MICE AS AN EXPERIMENTAL ANIMAL:

Laboratory animals particularly mice (Mus-Musculus) are being used as a prime model for research work. Their big demands are observed from the research laboratories in different periods (Agarwal et al 2006). Upto 80% of all animals used in laboratories is mice. Mice are used as animal models for research in different fields such as – for biomedical research in microbiology, genetics, oncology, toxicology, genetic studies, developmental biology, behaviour research, nutrition etc.

Various nutrition workers conducted growth experiment on mice and rats. Joseph et al (1962) studied the supplementary value of processed protein food for
maize and tapioca diet by conducting growth experiment or rats. Narayanaswamy et al. (1971) prepared a low cost protein food based on blend of wheat and soya flour and observed growth in rats. Sabiha and Pushpamma (1973) studied the supplementary value of autoclaved full fat soyabean to sorghum by growth studies on weanling rats. Bressani et al. (1974), Baroova and Chittemma Rao (1979), Mazumdar (2006) also conducted growth experiments on albino mice.

Gupta, H.O. (1994), Goyle and Gujral (1998), Suchitra et al. (2003) studied the protein quality of maize, biscuits prepared from malted / raw mix with or without colocasia leaf powder and wheat protein quality respectively, where albino mice was used as experimental animal. Verma et al. (1999); Verma et al. (2001) studied Haemato-bio-chemical, histological and electrophoretic fractionation of blood protein of albino rats after giving dietary supplementation of cultivated mushroom. Sarma (2000) also studied the hepato protective action of Terminalia Chebula on rats.

Singh and Sanyal (2003) carried out experiment on mice to study the effect of undernutrition on body growth, bran size and brain bio-chemicals. Thus, the widespread use of mice as an experimental animal might be due to its high fertility rate, short gestation period, smaller body size, ease of maintenance, and resistance to different infectious agents and susceptibility to non-infectious or genetic diseases that could affect humans (ILAR, 1995).

While using mice as an experimental animal, they must be kept in a well ventilated room with the temperature about 70 ° F and humidity at 50%. The room
should be airy, spacious and should have appropriate light. Because too much of bright light might hurt the eyes of white albino mice.

Mice are omnivorous. Therefore their feed stuff consists of foods from both plant and animal origin. These types of feed ingredients are commercially available. Some of the feed ingredients used in the laboratory are dried skimmed milk powder, dry molasses, ground yellow shelled corn, ground wheat, whole oats, wheat bran, ground maize, soyabean oil, broken rice, soyabean meal, dried yeast, fish meal, corn gluten meal, steamed bone meal, alfalfa meal etc.

In the present investigation, the effect of *alocasia indica* powder was studied on the growth performance, changes in the liver and kidney and dietary effect of albino mice in terms of serum protein and blood glucose. The effect of *Alocasia Indica* powder was also studied on the growth performance, changes in height, weight, haemoglobin, total serum protein and intelligence level in malnourished children.

**E.01. MALNUTRITION - PREVALENCE AND EFFECT ON PRE-SCHOOL CHILDREN:**

Malnutrition is a condition resulting from the deficiency or excess intake of calories and one or more nutrients (Devdas, 2001). It is the result of inadequate dietary intake and / or disease (Ray, 2002). According to Sullivan and Sheffrin (2003), it is a general term for a medical condition caused by an improper or inadequate diet and nutrition. Malnutrition is the condition that develops when the
body does not get the right amount of vitamins, minerals and other nutrients, it needs to maintain healthy tissue and organ function (Smith, 2005).

Malnutrition is a global problem and found to the greatest extent where poverty is the rule and not exception and where ignorance and superstitions are rampant. (Lowerberg et al., 2007). About 15 Percent of India’s population is pre-scholars and most of them suffer from malnutrition (Gopalan, 1972). It has been estimated that – about half of the population of developing countries cannot afford a diet that meets their minimum energy need for a healthy active life. (FAO, 1977).

According to the world food programme, (2007) malnutrition is a lack of proper nutrition. It occurs when the body does not receive enough nourishing food. Even if people get enough to eat, they can become malnourished, if the food eaten does not provide adequate amounts of macro or micronutrients to meet daily nutritional requirements. The World Bank group (2008) revealed that – the most common underlying cause of malnutrition is poverty. Poor people cannot afford to buy food with adequate calorie, vitamin and minerals.

Many factors are interrelated to precipitate malnutrition in a country like ours. Poverty leading to low food intake, low food intake leading to reduced body weight and low levels of activity, low levels of activity leading to decreased productivity and this leads to still greater poverty. (Sukhatme, 1982). According to WHO (2006) hunger and malnutrition are the single greatest threats to the world’s public health and malnutrition is by far the biggest constitute to child mortality present in half of all cases.
According to 1981 census, per capita availability of food grain was 194.5 kg/year. Food grain demand in the 2000 AD for an anticipated population of 935.35 million has been estimated to be within the range of 168.29 to 182.10 million tones for direct human consumption (Jain, 1984). The present situation is that average calorie consumption by an Indian is 2068 kilocalorie and protein 50.4 g per day (NNMB, 1980) as against ICMR recommended intake of 2400 kilo calorie and 55 g per day. This signifies poor quality of diet of average Indians. The cost of malnutrition has been estimated at 2-3% of the Gross Domestic Product (GDP) per year on the country’s economy (Gragnaloti et al, 2006).

Amongst the developing nations, food situation in India is most alarming because of its very large and variegated population. A rising human population gives rise to diverse kinds of demands but none of these is as insistent as the demand for increase food supply (Baroova, 1988). Millions of people lack the minimum means to be able to compete for food to obtain nutritionally balanced diet. One of the most formidable tasks India faces today is to help her chronically underfed millions especially the vulnerable groups to reach a healthy nutritional level. (Devdas et al. 1982). Malnutrition is still an important public health problem, which receives less priority as well as less research finding (Ray, 2005). Added to nutritional deficiencies, problems such as traditional beliefs, fads and fallacies aggravate malnutrition. The replacement of millets with refined rice or maida leading to decreased fibre consumption, excessive consumption of refined calories and decreased physical activity are also the causative factors for the increasing occurrence of malnutrition.
E. 02. PREVALENCE:

India is the home of 10% of the world's children (UNICEF, 2004). Pre-school children constitute most vulnerable segment of any community (Rao et al 2005). Their nutritional status is a sensitive indicator of community health and nutrition (Sachdev, 1995). Undernutrition among them is one of the greatest public health problems in developing countries. About 128 million (70%) of the world's 182 million stunted children aged under five years live in Asia (Allen and Gillespie, 2001).

Pre-schoolers in India constitute 15% of the total population as against 7% in the developed countries of the world. (Bhatt and Dahia, 1985). Nutrition of these pre-schoolers is of prime importance as they are most vulnerable to malnutrition (Tripathi and Sharma, 2006). WHO (1994) reports that – half of the under weight children in the world live in Asia and in Africa. According to the Global Hunger Index, (GHI, 2008), South Asia has the highest child mortality rate of world's region. India constitutes to about 5.6 million children death every year, more than half of the world's total (B.B.C. 2006). According to FAO (2008) India had 217.08 million undernourished people in 2001-03. There were 923 million hungry people in the world in 2007, an increase of 80 million since 1990.

According to Ray (2005), out of the 12 million children under five years of age that die each year in the developing countries mainly from preventable cause, the death of over six million or 55 percent are either directly or indirectly attributable to malnutrition. Desai et al (2005) revealed that – in India child...
mortality between months 1 and 12 is forty percent higher for girls than boys. In India, almost half of the children (47 percent) under three years of age are underweight, a similar proportion is malnourished to the extent that they are stunted (46 percent). Upto 80 percent of all children who die of causes related to malnutrition are only mildly or moderately affected and a lack of only 200-300 calories in young children’s daily diet may sometimes lead to illness, malnutrition and possibly death (UNICEF, 1995).

It is estimated that – undernutrition contributes to the deaths of about 5.6 million children under the age of five. One out of every four children under 5 or 146 million children in the developing world is underweight to his or her age and at increased risk of an early death. Of these, 57 million live in India (SHRDC, 2005). Asia has the highest levels of underweight, affecting 46 percent of all under five children in the region.

Malnutrition is particularly prevalent in developing countries, where it affects one out of every three pre-school age children (Salah et al 2008). The pre-school child was particularly vulnerable to malnutrition and mortality rates were quite high, after exceeding 50 percent in the first five years of life. (Owen et al, 1974). According to Bulusu, (2005), everyday, more than 6,000 children below the age of five die in India. More than half of these deaths are caused by malnutrition.

The WHO (2000) has estimated that – 182 million children representing 32.5 percent of all pre-school children under five years of age in developing countries are malnourished and over two thirds of them live in Asia, especially
Southern Asia. Poverty is the root cause of malnutrition. Several studies have found out that – children of poor families are more prone to suffering malnutrition (Li et al, 1999; Odunaya and Oyewille, 2006).

Malnutrition is a wide spread public health problem in developing countries. According to FAO (2002), 799 million people in the developing world were chronically undernourished in 1988-2000. Historical data indicate that – more than half of the world’s PEM problems is in South Asia. In 1990 about 100 million out of 184 million underweight children in the world were found in the subcontinent comprising India, Pakistan, Bangladesh, Nepal, Sri Lanka and Bhutan.

E. 03. EFFECTS OF MALNUTRITION:

Malnutrition occurs in people who are undernourished or overnourished. In India, Pre-school children and pregnant mothers are the worst sufferers of several degrees of malnutrition, especially PEM and under nutrition. Malnutrition is an underlying factor in many diseases in both children and adults and it contributes greatly to the disability among people worldwide. Malnutrition directly or indirectly affects socio-economic development of the society and is one of the most important determinants of long term development.

According to Dipti et al (2008), malnutrition adversely affects an individual's physical and mental development, productivity and the span of productive years. Thus, significantly influencing the social behaviour and economic potential of man. Infants and children are mostly affected. If malnutrition in
childhood continues to exist and increase, the development of the nation’s human resource potential is adversely affected and in turn affects national development. Malnutrition is the biggest single contributor to child mortality in the developing countries. Malnourished children who survive may be physically and mentally handicapped irreparably (FAO, 1970). Malnourished children are more susceptible to infection (Puffer et al., 1973). According to Pryer (1993), malnourished children have a more severe or protracted illness and higher risks of mortality.

Alderman and King, (2006) revealed that early malnutrition weakens children’s physical and cognitive potential and even their non-cognitive traits such as motivation and persistence, so it is costly for their future health, educational attainment and socio-economic success. According to Salah et al (2008), malnutrition affect physical growth, morbidity, mortality, cognitive development, reproduction and physical work capacity and it consequently impacts on human performance, health and survival. It is an underlying factor in many diseases for both children and adults. Malnutrition lowers resistance to disease, resulting in higher morbidity, apathy, lethargy and reduction of working efficiency (Devdas, 2001). This leads to low income, low standard of living, poverty and infection. Besides inhibiting child growth, malnutrition increases morbidity, affects cognitive development and reduces educational performance and future labour productivity (Mekhlafi et al, 2008).

The foundation of good health is laid during the early childhood which is the dynamic period of physical growth and development along with mental, emotional and social change (Devdas, 2003). Nutritional deficiency during this period may
lead to malnutrition. In a study conducted by Vijayalakshmi et al (2008) revealed that — malnourished children have lowered resistance to infection and frequent illness saps their nutritional status, locking them into a vicious cycle of recurring sickness, faltering growth and diminished learning ability. Malnutrition also results in poor cognitive development and impairment of memory, deficient in learning and poor I.Q.

The first five years of a child life is very critical. During this period, children develop their ability to think, speak, learn and reason and lay the foundation for their values and social behaviour as adults (Bhandari et al, 2006). If these developments are interrupted by nutritional deficiency or by malnutrition, irreversible damage could result. According to Balgir et al (1998), malnourished children are shorter than what they should be for their age; poor linear growth during childhood and failure to maximize genetic potential are often associated with impaired cognitive development and behavioural abnormalities. Gowri and Manjusha (2003) reported that — malnutrition in children stunts physical growth, impair mental ability and leads to poor education and low productivity. Server PEM in children during early infancy may affect brain size and intellectual development. (Singh and Sanyal, 2003).

F. SUPPLEMENTARY FEEDING AND PRACTICAL FEEDING EXPERIENCY WITH HUMAN SUBJECTS:

High morbidity and widespread malnutrition in young children are common symptoms in the disadvantaged section of the third world countries. The poor socio
economic condition that exists in these countries has forced many families to live in an extreme state of deprivation. To improve child health and nutrition within these adverse socio-economic settings, supplementary feeding should be the main thrust of nutrition activity (Henry and Cooper, 1986).

It is well recognized that supplementary feeding are only stop gap arrangements to alleviate malnutrition in vulnerable segments of the population. Several workers have studied the effect of food supplementation on malnourished people. Devdas and Radharukmani (1964) studied the effect of a free midday meal supplied for 5 months on the height & weight of boys and girls between 5 and 7 years of age in an Indian school. Data revealed that experimental group had higher height and weight than the control group.

Kaur and Bhat (1979) revealed that supplementation of cheap local foods increased growth and improved the nutritional status of children below school age

Naidu and Hanumantha Rao (1979) evaluated the supplementary feeding programme using some anthropometric indices and demonstrated that the gain in weight and height of 1-5 years old children received food supplements for a period of 14 months was significantly more than that of unsupplemented children.

Rao and Sastry (1985) evaluated the special Nutrition Programme (SNP) in the tribal areas of Andhra Pradesh and reported that supplemented children had
lower prevalence of milder forms of PCM and growth status was superior to that of un-supplemented children.

A study was performed by Lutter et al (1991) to assess the response of 120 children from birth to three years to food supplementation. The children were studied over three month intervals and were compared with a control group of 112 unsupplemented children. The best response to supplementation was observed from age three to six months and supplemented group gained 162 grams more than the unsupplemented group. The results suggest that to prevent malnutrition effectively, supplementary feeding is more beneficial.

Supplementary feeding by using different indigenous food should be given for treating children who are malnourished. Some studies have reported that the rates of recovery from Protein Energy Malnutrition (PEM) was as high as 40 to 80 percent, while some others have reported small effects of supplementary feeding on growth (Habicht et al, 1991).

Subramanyan et al (1997) conducted a feeding experiment for a period of five months on 4-12 years girls in an orphanage by supplementing a multipurpose food composed of groundnut flour and Bengal gram flour fortified with certain vitamins and calcium phosphate. There was significant increase in weight and haemoglobin levels of subjects receiving supplements. Carruth et al (2000) studied the effect of supplementary foods on infant growth and revealed that there was significant weight gain between 12-24 months old children. In another study by Pollitt et al, (2000) evaluated the effect of energy and micronutrient supplementation on the motor development of nutritionally disadvantaged infants.
and young children in Indonesia. It was found that early supplementary feeding had an impact on motor development in 12 months old children.

WHO (2002) studied the effect of food supplementation among children between ages six to forty eight months in rural Guatemala by supplementing two villages, one village with high protein, high energy drink called ‘Atole’ and the other village with a low energy, non protein supplement called ‘Fresco’. The two supplements contained similar amounts of vitamins and minerals. After three months, the rate of recovery from wasting was 12 percent higher for the children receiving Atole drink than those treated with Fresco. Maize and Soy flour mixes are often used in the treatment of malnutrition in Malawi and promotes growth among severely malnourished children. (Maleta et al 2004).

Vijaylakshmi et al, (2008) reported that – supplementation of a health drink enriched with micronutrients can stimulate the physical and cognitive development of children.

Saradha and Rajeswari, (2008) studied the effect of supplementation of Quail’s egg on selected malnourished pre-schoolers and revealed that – supplementation of 50 gm of Quail’s egg to malnourished pre-school children for a period of 8 weeks showed an improvement in weight, serum protein and haemoglobin level.

From the above studies it has been seen – food supplementation is beneficial for treating malnourished children. Intervention through supplementation is a
critical aspect of caring young children's health. Intervention leads to improved physical and mental development (Squassero et al, 2005). They also noted a low number of food supplementation trials in developing countries using low cost foods and therefore emphasizing the need for long term food supplementation studies in assessing growth in children. The nutritionists can help in analysing the food for nutrients, introducing novel nutritive foods in the dietary patterns and developing new infant weaning foods and low cost recipes to prevent malnutrition (Devdas, 2001)