Chapter-II

REVIEW OF LITERATURE

The pre-requisite of any research work to be conducted is to make clear all the concepts related to the problems followed by a systematic and meticulous future planning. The knowledge of scientific literature in the related field of research problem therefore, is of great importance in carrying out future research work. It not only provides impetus in understanding the problem in a precise, clear and comprehensive manner, but also helps in gearing up and updating the research work.

It becomes therefore, quite imperative for every research worker to critically review the related research work already carried out so as to get a broad spectrum and insight for the research problem. For this reason, the research work already done in India and abroad relating to the topic of present study has been reviewed under the following sub-heads:

2.1 Nutritional composition
2.2 Antinutritional factors
2.3 Biological studies
2.4 Value-added food products

2.1 Nutritional composition

Jong et al. in 1995 investigated the effects of roasting on volatile flavour compounds in Cassia tora seeds. After roasting (190-230°C for 10-40 min), volatile flavour compounds were extracted from seeds by a steam distillation-extraction method and identified. Raw seeds contained 7 volatile flavour compounds. Roasted seeds
contained 38 volatile flavour compounds, including 3 pyrazines, 4 pyrroles or pyridines, 4 alcohols, 11 aldehydes or ketones, 9 furans or phenols and 7 others. Many other flavour compounds were also formed during the roasting process. Pyrazines and furans were the major volatile flavour compounds in roasted Cassia tora seeds, and their contents increased with increasing roasting time; contents of aldehydes, ketones, alcohols and pyridines did not increase significantly.

Biological evaluation of some forest tree seeds (viz. Cassia tora, Delonix regia, Crotalaria laburnifolia, Acacia leucophloea, and Albizia procera) was made by Tomar et al. in 1996, with a view to determining their nutritional qualities. All seeds were rich in protein, with the highest protein content in Crotalaria laburnifolia (39.02%) and Albizia procera (35.35%), with the remaining species showing a range of 21-25% protein. Carbohydrate contents were in the range of 41.81-55.78%. All the species were poor in fat (2.56-5.32%). Fiber content varied from 2.75 to 5.21%, and ash content from 3.25 to 5.29%. Calcium was high in Acacia leucophloea, and phosphorus and iron in Albizia procera.

Barminas et al. in 1999 analyzed mineral composition of 6 wild or semi-wild leafy vegetables commonly eaten in rural areas of Nigeria. Vegetables studied were: Amaranthus spinosus, baobab (Adansonia digitata), Cassia tora, taro (Colocasia esculenta), Corchorus tridens and Moringa oleifera. Amaranthus spinosus and baobab leaves contained the highest levels of iron (38.4 and 30.6mg/100g dry wt., respectively). All vegetables studied contained high levels of calcium, compared with common vegetables. Zinc content was highest in Moringa oleifera, baobab and Cassia tora leaves (25.5, 22.4 and 20.9mg/100g dry weight, respectively). Mean daily intake of phosphorus,
magnesium, calcium, iron, copper and zinc were lower than their RDA values. Daily intake of manganese was not, however, significantly different (P ≤ 0.05) from the RDA value.

Four accessions of a lesser-known legume, *Cassia obtusifolia* L. (Sickle pod), collected from four different agro climatic regions of Western ghats were studied by Vadivel and Janardhanan (2002). Evaluation for chemical composition was done and it was reported that crude protein ranged from 18.56-22.93%, crude lipid was between 5.35-7.40%, crude fiber ranged from 6.83-9.45%, ash content ranged from 5.14-5.83% and carbohydrate varied from 57.00-60.69%. Globulins constituted the bulk of the seed protein as in most legumes. Mineral profiles, viz., sodium, potassium, calcium, magnesium, phosphorus, iron, copper, zinc and manganese ranged from 42.92-84.83, 758.05-1555.79, 559.92-791.72, 456.36-709.47, 629.13-947.79, 8.42-12.35, 0.93-2.06, 10.60-30.04 and 2.12-4.12mg/100g seed flour, respectively. Seed proteins of all accessions exhibited relatively high levels of non-essential and essential amino acids, with the exception of threonine. The *in vitro* protein digestibility of the legumes ranged from 74.66 to 81.44%.

An attempt was made by Sheela *et al.* in 2004 to identify and analyze the various underutilized green leafy vegetables for their nutrient content from selected regions of southern Karnataka. Samples of 38 underutilized green leafy vegetables including *Cassia tora* were identified. Out of all these 38 foods it was reported that moisture, protein, fat, fiber, carbohydrate and energy content of *Cassia tora* was 85%, 0.7g, 2.0g, 0.9g, 1.4g, 17 Kcal respectively.
Rathore and Meena in 2005 assessed the nutrient content of several edible wild plants used during the times of difficulty. Crude protein contents of seeds, leaves and branches of locally used famine foods of arid region including potential exotic acacias were determined. The crude protein of bark of *Acacia leucophoea*, *Acacia nilotica* and *Prosopis cineraria* were found to be 18.7, 13.7 and 23.1% respectively. The leaves of *Cleome viscose*, *Aerva javanica*, *Cassia tora* and *Balanites aegyptiaca* were found to contain 29.9, 29.3, 1.9 and 26.3% protein respectively. Acacia seeds contained maximum amount of crude protein viz. *Acacia senegal* was found to contain 35.8% protein.

### 2.2 Antinutritional factors

Leaf protein concentrates from several tropical plants (*Manihot esculenta*, *Leucaena* species, *Desmodium distortum*, *Cassia tora*, *Phaseolus calcaratus*, *P. sathywide*, *Psophocarpus tetragonolobus* and *Brassica napus*) were evaluated for nutritional potential by Osuntogun *et al.* in 1987. Leaf protein concentrates from *Manihot esculenta* contained most tannin (13.5mg/g) and that from *Desmodium distortum* least (2.0mg/g). Available lysine (3.6-5.8g/16g N) was negatively correlated with tannin concentration. \( r = -0.670 \), as were digestibility and protein efficiency ratio. Leaf protein concentrates showed promise as protein sources, but their tannin content is a major constraint to their full exploitation in the human diet.

Vadivel and Janardhanan (2002) studied antinutritional substances in the accessions of *Cassia obtusifolia*, collected from Western ghats, south India. Total free phenolics ranged from 0.34-0.66%; tannins were between 0.47-0.60%; L-DOPA content ranged from 0.98-1.34%; trypsin inhibitor activity varied from 11.4-13.5 TIU/mg protein
and chymotrypsin inhibitor activity ranged from 10.8-12.3 CIU/mg protein. Phytohemagglutinating activity also was assayed. The accessions of *Cassia obtusifolia*, collected from Western ghats, south India, could serve as a low-cost source of some important nutrients for humans.

Haritha & Maheswari in 2007 assessed the effect of different processing methods on the antinutritional factors viz. oxalic acid, phytate phosphorus, tannin content and antimicrobial activity of *Cassia tora* seeds in order to assess the feasibility of utilizing the weed seeds as a rich food source of protein. The results indicated that oxalic acid content was significantly reduced in all processing methods viz., 18 hrs soaked, 24 hrs soaked, germinated, roasted, pressure cooked, and microwave cooked. Except in 12 hrs soaked and boiled seeds, significant reduction was observed in tannin content in all the processing methods studied. The content of phytate phosphorous was also significantly reduced except in seeds soaked for 12 hrs and 18 hrs.

### 2.3 Biological studies

Toxicological screening on seeds of five wild leguminous plants: *Delonix regia, Cassia tora, Sesbania sesban, Crotalaria naragutensis and Tamarindus indica* was carried out by Kadiri *et al.* in 1996. The animals used in the toxicological screening were mice and rats. The leguminous seeds had varied protein contents i.e. 21.1% for *Sesbania sesban* and 47.7% for *Crotalaria naragutensis*, while the mineral elements detected in appreciable quantities were calcium, magnesium, potassium, iron, copper, zinc, phosphorus and sodium. Oxalate contents were very low, between 0.03% for *Sesbania sesban* and 0.09% for *Cassia tora*. Acute toxicity tests for 12 days using mice and rats given water extracts of the 5 legumes orally and intraperitoneally were negative. The
legumes increased body weight of the rats and mice when compared with controls that were given distilled water. There were also increases in blood protein and blood sugar in rats injected intraperitoneally with concentrated water extracts. Similar results were obtained in the prolonged toxicity screening.

A study was conducted by Ng, L.T. in 1997 to test the efficacy of *Cassia tora* and *Ampelopsis* species as herbal drink for weight loss, with *Ampelopsis* species being evaluated as a control with no reported effect on weight control. Both acute and chronic effects of *Cassia tora* and *Ampelopsis* species extracts on food intake and body weight were examined. Male wistar rats, adapted to a 14 hrs feeding schedule (food was available only during the dark period), received *Cassia tora* or *Ampelopsis* species extracts intragastrically (0.2g/4ml/rat) 30 min prior to food presentation. Acute administration of either *Cassia tora* or *Ampelopsis* species extracts failed to suppress short-term food intake (at 0-1, 1-2 and 2-14 hrs time period). Furthermore, long-term food intake and body weight were also not affected by chronic administration of these extracts. This study did not find evidence to support the reported claim that *Cassia tora* has weight reduction properties. Under these dosages, food intake and body weight were not affected by either acute or chronic administration of *Cassia tora* or *Ampelopsis* species extracts.

Jaw *et al.* in 2008 evaluated the immunostimulatory activities of four anthraquinones of *Cassia tora* (aloe-emodin, emodin, chrysophanol, and rhein) on human peripheral blood mononuclear cells. Studies were conducted on lymphocyte proliferation, secretion of interferon-gamma (IFN-γ) and interleukin 10 (IL-10) by an ELISA assay and elucidation of responding immune cells by flow cytometry. The results showed that at non-cytotoxic concentrations, the tested anthraquinones were effective in stimulating the
proliferation of resting human peripheral blood mononuclear cells and/or secretion of IFN-γ. However, at the concentration of 10 μg/ml (35 μM), rhein significantly stimulated proliferation of resting human peripheral blood mononuclear cells (stimulation index (SI) = 1.53), but inhibited IFN-γ secretion (74.5% of control). The augmentation of lymphocyte proliferation was correlated to the increase in number of CD4+ T cells, while the elevated secretion of IFN-γ and IL-10 might have been due to the activated CD4+ T cells.

2.5 Value-added food products

It has been reported by Zhenbao et al. in 2006 that, Juemingzi i.e. seed of the legume Cassia tora L., is an important medicinal plant, which is well known to have pharmacological activities such as diuretic, diarrhea and antihypertension that have been used by many people from ancient time. Water extracts from Juemingzi have favourable flavour, and most of it was conventionally consumed as a healthy tea beverage in China. Methanol extract from Cassia tora seeds has demonstrated inhibitory effect on lipid peroxidation.

According to Solanke 2007, Cassia tora L. is a well known oriental herb in traditional medicine. Its seeds are used as coffee substitute, health drink and in curing several human ailments. The seeds of Cassia tora contain a variety of bioactive anthraquinones including emodin, chrysophanol and rhein etc. which are mainly responsible for pharmacological action ascribed to them. Anthraquinones present in Cassia tora seeds have also been found to be mutagenic and cytotoxic in prokaryotic and eukaryotic cells.