RESEARCH PAPER | International Journal of Agricultural Engineering | Volume 12 | Issue 2 | October, 2019 | 235-242
ISSN–0974–2662 ■ Visit us : *www.researchjournal.co.in* ■ **DOI: 10.15740/HAS/IJAE/12.2/235-242**

Study of physico-chemical properties of *Cassia tora* Linn. leaves powder

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Received : 08.08.2019; **Revised :** 26.08.2019; **Accepted :** 13.09.2019

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■ **ABSTRACT :** The study was undertaken to know the physico-chemical properties of *Cassia tora* powder obtained by drying at 60^0C and packed 100,200,300 gauges poly bags and stored for 60,120 and 180 days at room temperature. It was observed that *Cassia tora* leaves powder consists of m.c.(%), ash (%), protein (%), ascorbic acid (mg/100g), chlorophyll (mg/100g), fibre (%), calcium (g/100g) and fat (%) of was 4.07, 8.15, 12.51, 19.6, 39.68, 27.42, 3.52 and 2.002, respectively. This shows the rich profile of *Cassia tora* which could be an important component of diet in future. The colour values *i.e.* L*, a* and b* of powder were 58.608, -5.245 and 21.132, respectively showing acceptable colour values as leafy vegetable. It was also observed that there was no significant effect of packaging on moisture content of the powder upto 180 days but it showed little effect on protein and ascorbic acid content. Interaction of treatments showed non-significant effect on the moisture and protein content but showed little effect on ascorbic acid content. All the treatments of packaging showed non-significant effect of storage on fibre and calcium content where as little effect on fat content of the powder. Powder stored for a period of 60, 120 and 180 days showed little effect on fibre, calcium and fat content and treatment interaction also showed non-significant effect on the constituents.

■ **KEY WORDS :** Physico-chemical properties, Leaves, Powder

■ **HOW TO CITE THIS PAPER :** Kamble, K. J. and Dhage, Shubhangi (2019). Study of physico-chemical properties of *Cassia tora* Linn. leaves powder. *Internat. J. Agric. Engg.*, **12**(2) : 235-242, **DOI: 10.15740/HAS/IJAE/12.2/235-242.**

Tarwad (*Cassia tora* L.) is a plant having many nutritional compositions and medicinal properties. It is grown in fallow land and road sides, is not used mostly for food purposes (The Wealth of India,1992). Its leaves consists of lipids crude fibre, crude protein, COH 36.60, calcium, iron, sodium, magnesium, zinc, manganese, cobalt and potassium (Kubmarawa *et al.*,2011) but it is not commonly used. Government reports from India stress poor nutritional status of tribal people with stunting (63 %) of children and chronic energy deficiency in adults (49 % in men and 55 % in women). There is need to promote food-based approaches that draw on indigenous food systems relevant to classic problems of hunger and nutrient deficiencies as well as to addressing the problem of non-communicable diseases (Nandi and Bhattacharjee, 2013). Considering the view of utilization of *Cassia tora* leaves in foods, the necessary study was undertaken in the Dept. of Agricultural Process Engineering, in MPKV, Rahuri with the objectives.

Cassia tora, family, Leguminasea, commonly known as sickle senna, wild senna (The Wealth of India,1992) or sickle (Sui-Ming *et al.*, 1989) is a foetid annual herb. It occurs throughout India on fallow lands

as a weed. It grows on hills of low elevations upto 1,800 m and in plains. Plant is of 30 - 90 cm height, green leaves, flowers yellow, fruits subtetragenous obliquely septate pods, 15-23 cm long, 23-30 seeds per pod (4 angled). The young shoots and leaves of this exotic vegetable are consumed as vegetable in the rural areas.

Leaves and seeds are acrid, thermogenic, laxative depurative, antiperiodic, liver tonic, antihelmintic, cardiotonic and are useful in ringworm, pruritis, leprosy, skin disease, hepatopathy, helminthiasis, flatulence, dyspepsia, intermittent fevers, constipation, ophthalmopathy, cough, bronchitis, cardiac disorders, haemorrhoids, antifungal, hypolipidemic, hepatoprotective, and hypotensive activities.The plant is claimed to be effective against a variety of ailments in indigenous medicine such as in treatment of jaundice. In Chinese medicine, it is highly valued for the treatment of hyperlipidemia. Several polyherbal, formulations are available in Chinese market for preventing the formation of atherosclerosis plaque (Dubey and Sawant, 2015).

Kubmarawa *et al.* (2011) reported that *Cassia tora* leaves contain crude protein 11.63 per cent, crude fibre were 27.07 per cent in and it contains moisture 12.82 per cent, ash content (%) 9.86, lipids (%)2.02, crude fibre (%) 27.07, crude protein (%) 11.63, carbohydrate (%) 36.60, calsium 3.52, iron 0.22, sodium 0.10, mgnesium 0.86, zinc 0.04, manganese 0.10 +0.02, cobalt 0.02, potassium 0.96. Carbohydrates, lipids, moisture and ash contents were within the range expected for dry leafy vegetables. Seventeen amino acids were found in varying proportions in the plants.

Tarwad leaves also found to have the presence of tannins, steroids and triterpenoids in all the four extracts namely, choloroform, ethyl acetate, ethanol and hydroethanol extracts. It was observed that alkaloids were present only in the chloroform extracts (Rao and Chattrerjee, 2016 and Ansari and Bhot, 2017). Pawar and D'mello (2011) reported the presence of anthraquinone glycosides and flavonoids in the *Cassia tora* leaves. The anthraquinone glycoside includes rhein, emodine, physion, chrysophanol (marker), obtusin, chrysoobtusin, chryso-obtusin-2-O-β-D-glucoside, obtusifolin and chryso-obtusifolin-2-O-β-D-glucoside 3, 4. Sennosides, which are well known for their medicinal importance, have been also detected in the leaves of the plant. The sennoside content in the leaf of tarwad was found to be 0.14 per cent and also Kaempferol-3-diglucoside (*Flavonol glycoside*). A potential hepatoprotective constituent, ononitol monohydrate, was isolated from *Cassia tora* leaves.

Fathalla *et al.* (2015) reported that total and defatted alcoholic extracts of seed were screened for hepato-protective activity using adult Wister albino rats (120-170 g) as the experimental animals. They reported the presence of carbohydrates, glycosides, anthraquinones, flavonoids, fats, saponins and gums. The alcoholic extracts of the seeds (total or defatted) found effective against toxicity induced by CCl_4 and significant hepatoprotective effect (Veerachari and Bopaiah, 2012). Rao and Chattrerjee (2016) reported that *Cassia tora* is an annual foetid herb, with a height of 30 to 90 cm, *Cassia tora* is mainly found in the states of Uttar Pradesh and Madhya Pradesh, in India. It has pinnate leaves, which are about 10 cm long. Each leaf has three pairs of leaflets that are opposite, ovate, oblong and oblique at the base. The yellow-coloured flowers are bearded in the axel of the leaves. The flowers comprises of five petals, each about half inch in diameter. The seeds of *Cassia tora* are rhombohedral and brown in colour, about 30 to 50 in number. The plant bears flowers in the rainy season and fruits in the winter.

Uses of tarwad leaves:

Cassia tora is traditionally used as vegetables by villagers and tribal people. It has various medicinal and ayurvedic uses. It contains many medicinal properties which are useful on various diseases.Antimicrobial activity of ethanolic extract (0.15mg) and aqueous extract (0.31mg) against various bacteria is observed but maximum activity is shown by aqueous extract against *Staphylococcus aureus*, *Lactobacillus* and showed moderate activity against *Pseudomonas aeruginosa*, *P. vulgaris* and *Enterobacter* and less activity against *Bacillus subtilis* and *Eschieria coli*. But aqueous extract did not show any activity against *Salmonella typhi*. While ethanolic extract showed less activity as compared to aqueous extract but showed maximum activity against *Staphylococcus aureus* and *Lactobacillus* as comparative to standard (Supare and Patil, 2011).

Choudhary *et al.* (2011) reported that in Andhra Pradesh, the tribal people had been using the leaves of this plant ground along with peppers and water into a paste, for the treatment of jaundice. The paste of leaves

can also be applied to ringworm and eczema. Decoction of leaves and flowers is used internally for bronchitis and asthma. Plant pacifies vitiated tridosha, dandruff, constipation, cough, hepatitis, fever and haemorrhoids. The leaves are antiperiodic, alterative, aperient and given to children having intestinal disorders. The leaves, roots, and even the whole plant are employed in the treatment of impetigo, ulcers, helmenthiasis and as a purgative.

Rao and Chattrerjee (2016) reported the traditional uses and properties of *Cassia tora* and uses in management of various diseases in India and China.

– *Cassia tora* is used as a coffee substitute and has a maturing and anodyne action.

– Antimicrobial, antihepatotoxic and antimutagenic activities have been attributed to this plant hence, used to treat constipation, oedema, glaucoma, nyctalopia, conjunctivitis, hypertension and hypercholestrolemic, liver damage and sometimes eaten as vegetable.

– It is very useful in treating skin diseases like ringworm and itching or body scratch and psoriasis.

– The alcoholic or vinegar maceration of pounded fresh leaves is used externally to treat eczema and dermatomycosis.

– Decoction of the fruit of *Cassia tora* is used in the treatment of fever.

– It acts as a kapha and vatadosha suppressant, it acts as a nerve tonic.

– It is consumed in worm infestation and cures the infection occurring in the body.

– It acts as a liver stimulant, mild laxative and heart tonic.

– The herb helps the body in main taining the normal level of cholesterol.

– Its paste is used for treating skin ailments and also for getting rid of chronic diseases.

– It is also used in treating piles, hemorrhoids and relieves the pain caused on excretion.

– Its powder is useful in combating indigestion, toning up heart muscles and purifying blood.

– The juice extracted from its leaves is used in case of skin ailments, rashes and allergies. It is also used as an antidote in case of various poisonings.

– The leaves and seeds of *Cassia tora* are useful in leprosy, flatulence, colic, dyspepsia, constipation, cough, bronchitis and cardiac disorders.

– Due to lack of awareness about its nutritional value it is not commonly used. Government reports from India stress poor nutritional status of tribal people with stunting (63 %) of children and chronic energy deficiency in adults (49 % in men and 55 % in women). There is need to promote food-based approaches that draw on indigenous food systems relevant to classic problems of hunger and nutrient deficiencies as well as to addressing the problem of non-communicable diseases (Nandi and Bhattacharjee, 2013).

METHODOLOGY

Processing and value addition of *Cassia tora* leaves, seeds and plant part is essential to be used in preparation of various products in pharmacy and food industry. Fresh tender leaves were plucked carefully and gently with hands in the morning, washed, cleaned and used for further processing. Leaves were dried and analyzed to know the nutritional composition and properties of it.

Drying of leaves:

Tarwad leaves were collected and washed thoroughly to remove the dirt and dust adhered to it and blanching at 90°C for 2 min. Leaves were dried in cabinet drier to convert it in to a powder. After this the powder was then stored in polythene of 100,200,300 gauges at 60,120 and 180 days.

Experimental details:

Fresh tarwad leaves were collected,washed, cleaned, tied in a muslin cloth and kept immersed in boiling water for two minutes and cooled immediately under running tap water then drained in a colander to remove excess water. To standardize the drying temperature leaves were dried at 40, 50 and 60°C and milled to size less than 0.5 mm sieve size. It was observed that at 60°C was suitable for getting quality powder in short time. Powder was stored in polythene bags of 100, 200, 300 gauges at 60,120 and 180 days and proximate analysis *viz.*, protein, fats, carbohydrates, dietary fibre, moisture, ash and energy was done in accordance with AOAC (1992) method.

Treatment variables wereas below:

Packaging: P_1 - 100 gauges, P_2 - 200 gauges, P_3 - 300 gauges

Storage : S_1 - 60 days, S_2 - 120 days, S_3 - 180 days

The data obtained from chemical analysis of powder stored in different packaging materials were analyzed

Table A : Treatment details

Sr. No.	Treatments	Temperature (T °C)	Packaging (Gauge)	Storage (Days)
1.	P_1S_1	60	100	60
2.	P_1S_2	60	100	120
3.	P_1S_3	60	100	180
4.	P_2S_1	60	200	60
5.	P_2S_2	60	200	120
6.	P_2S_3	60	200	180
7.	P_3S_1	60	300	60
8.	P_3S_2	60	300	120
9.	P_3S_3	60	300	180

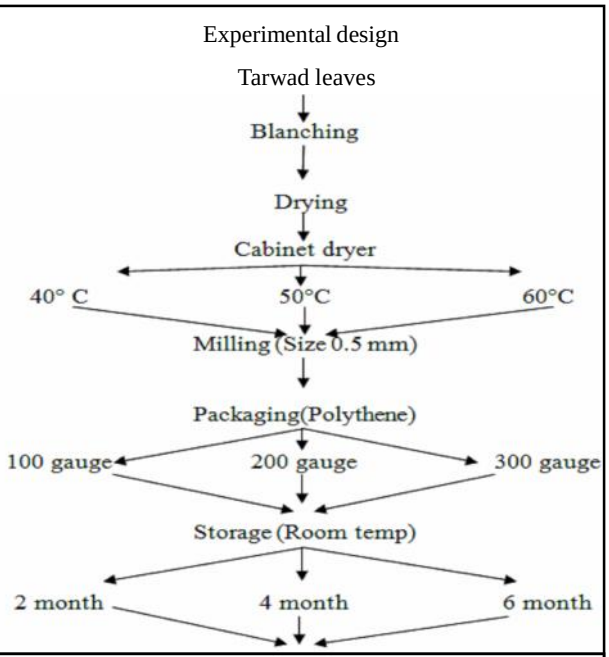

Fig. A : Experimental setup

for statistical significance according to the procedure given by Panse and Sukhatme (1957). All the experiments were planned and carried out using Completely Randomized Design.

■ RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Chemical composition of dehydrated leaves powder obtained by drying at 60 ^{0}C:

Table 1 shows that tarwad leaves powder prepared by drying at 60^{o}C temperature consisted of m.c. (%), ash (%), protein (%), ascorbic acid (mg/100g), chlorophyll (mg/100g), fibre (%), calcium (g/100g) and fat (%) were 4.07, 8.15, 12.51, 19.6, 39.68, 27.42, 3.52 and 2.002, respectively. This showed the rich profile of *Cassia tora* which could be an important component of diet in future.

The colour values *i.e.* L*, a* and b* of tarwad

Table 1 : Chemical composition of tarwad leaves powder

Sr.No.	Component	Temperature (60^{o}C)
1.	Moisture (%)	04.00
2.	Ash content (%)	08.15
3.	Protein (%)	12.51
4.	Ascorbic acid (mg/100g)	19.60
5.	Chlorophyll (mg/100g)	39.68
6.	Dietary fibre (%)	27.42
7.	Calcium (g/100g)	03.52
8.	Fat content (%)	02.00
9.	Colour values	
	L*	58.608
	a*	-5.245
	b*	21.132
	ΔE*	41.917

leaves powder obtained at 60^{0}C were 58.608, -5.245 and 21.132, respectively. Results show that drying of tarwad leaves at 60^{0}C retained good amount of colour parameters. Similar results were obtained by Shaikh and Syed (2015).

Effect of storage on moisture content of the *Cassia tora* leaves powder:

From Table 2 it is observed that the m.c. (%) of C*assia tora (*Tarwad) leaves powder packaged in 100 gauge polythene bag and stored for a period of 60, 120 and 180 days was found to be 4.48, 4.78 and 4.96, respectively. For powder packaged in 200 gauge polythene bag, it was found to be 4.39, 4.66 and 4.87 per cent for the period of storage of 60, 120 and 180 days, respectively. For powder packaged in 300 gauge polythene bag, it was found to be 4.39, 4.64 and 4.79 per cent at the storage period of 60, 120 and 180 days, respectively. From above results it is concluded that there was no significant change in moisture content during storage. Lowest moisture content was observed for the powder packaged in 300 gauge polythene bag.

Similar results were reported by Premavalli *et al.* (2001) for dhantu, khirkhire, honagone, chakota, palak, kachi and fenugreek (Singh *et al.*, 2003).

Effect of storage on protein content of *Cassia tora* leaves powder:

From Table 2 it is observed that the protein content of *Cassia tora* (Tarwad) leaves powder packaged in 100 gauge polythene bag, was found to be 11.96, 11.17 and 10.26 per cent at the storage period of 60, 120 and 180 days, respectively for powder packaged in 200 gauge polythene bag, it was found to be 12.21, 11.91 and 10.76 per cent at the storage period of 60, 120 and 180 days, respectively and for powder packaged in 300 gauge polythene bag, it was found to be 12.16, 11.93 and 10.88 per cent at the storage period of 60, 120 and 180 days, respectively. Results indicate that protein content was decreased during storage. Highest protein content was observed for the powder dried at 60^{o}C and packaged in 300 gauge polythene bag. Dehydration leads to

Table 2 : Effect of storage on m.c., ash, protein, and ascorbic acid of *Cassia tora* leaves powder

Treatments	Moisture	Protein	Ascorbic acid
P_1	5.71	10.63	0.192
P_2	5.62	10.87	0.193
P_3	5.56	10.98	0.194
S.E. ±	0.63	0.05	0.000
C.D. (P=0.05)	NS	0.14	0.000
S_1	5.41	11.53	0.194
S_2	5.67	10.91	0.193
S_3	5.81	10.03	0.192
S.E. ±	0.63	0.05	0.000
C.D. (P=0.05)	NS	0.14	0.000
P_1S_1	4.48	11.96	0.196
P_1S_2	4.78	11.17	0.194
P_1S_3	4.96	10.26	0.193
P_2S_1	4.39	12.21	0.196
P_2S_2	4.66	11.91	0.195
P_2S_3	4.87	10.76	0.194
P_3S_1	4.39	12.16	0.196
P_3S_2	4.64	11.93	0.195
P_3S_3	4.79	10.88	0.194
S.E. ±	1.89	0.15	0.000
C.D. (P=0.05)	NS	NS	0.001

NS= Non-significant

concentration of protein by 3-8 folds. Similar results have been reported by Singh *et al*. (2003).

Effect of storage on ascorbic acid content of *Cassia tora* leaves powder:

From Table 2 it is observed that the ascorbic acid content of *Cassia tora* (Tarwad) leaves powder packaged in 100 gauge polythene bag was found to be 0.196, 0.194 and 0.193 (g/100g) at the storage period of 60, 120 and 180 days, respectively for powder packaged in 200 gauge polythene bag, it was found to be 0.196, 0.195 and 0.194 (g/100g) at the storage period of 60, 120 and 180 days, respectively and for powder packaged in 300 gauge polythene bag, it was found to be 0.196, 0.195 and 0.194 (g/100g) at the storage period of 60, 120 and 180 days, respectively. Results indicate that ascorbic acid content decreased during storage. Highest ascorbic acid content was observed for the powder packaged in 300 gauge polythene bag. Similar results were reported by Singh *et al.* (2006) for both untreated and pre-treated fenugreek (methi).

Treatments of packaging and storage of powder for a period of 60,120 and 180 days shows non-significant effect on moisture content of the powder in storage up to 180 days but it shows little effect on protein and ascorbic acid content. Interaction of treatments showed non-significant effect on the moisture and protein content but little effect on ascorbic acid content.

Effect of storage on fibre content of *Cassia tora* leaves powder:

From Table 3 it is observed that fibre content of *Cassia tora* leaves powder packaged in 100 gauge polythene bag was found to be 26.83, 26.56 and 25.73 per cent at the storage period of 60, 120 and 180 days, respectively for powder packaged in 200 gauge polythene bag, it was found to be 26.83, 26.57 and 25.68 per cent at the storage period of 60, 120 and 180 days, respectively and for powder packaged in 300 gauge polythene bag, the dietary fibre content was found to be 27.13, 26.62, and 25.78 per cent at the storage period of 60, 120 and 180 days, respectively. From above results it is found

Table 3: Effect of storage on fibre, calcium and fat content of *Cassia tora* leaves powder

Treatments	Fibre	Calcium	Fat
P_1	26.14	3.44	69.85
P_2	26.12	3.47	71.17
P_3	26.15	3.45	53.35
S.E.±	0.07	0.02	0.00
C.D. (P=0.05)	NS	NS	0.00
S_1	26.83	3.50	1.99
S_2	26.25	3.43	1.57
S_3	25.33	3.43	1.61
S.E.±	0.07	0.02	0.00
C.D. (P=0.05)	0.20	0.05	0.00
$T_3P_1S_1$	26.83	3.57	2.03
$T_3P_1S_2$	26.56	3.58	2.03
$T_3P_1S_3$	25.73	3.53	2.00
$T_3P_2S_1$	26.83	3.56	2.02
$T_3P_2S_2$	26.57	3.46	2.00
$T_3P_2S_3$	25.68	3.69	1.98
$T_3P_3S_1$	27.13	3.56	2.05
$T_3P_3S_2$	26.62	3.55	2.07
$T_3P_3S_3$	25.78	3.52	1.96
S.E.±	0.21	0.06	0.06
C.D. (P=0.05)	NS	NS	NS

NS= Non-significant

that dietary fibre content decreased during storage. Highest dietary fibre content was observed for the powder packaged in 300 gauge polythene bag.

Dietary fibre is a sum of the polysaccharides and lignin which are not digested by endogenous secretions of the human gastro-intestinal tract. All fractions of dietary fibre are major structural components of plant cell wall. The total dietary fibre is further sub divided into soluble and insoluble depending on their solubility in water. Lignin, cellulose and some components of hemicelluloses form the insoluble dietary fibre. Major components of hemicelluloses, plant gums, pectin, β-glucon and mucilaginous matter are called soluble dietary fibre. Similar results were obtained by Kubmarawa *et al*. (2011) and Singh *et al*. (1997).

Effect of storage on calcium content of *Cassia tora* leaves powder

From Table 3 it is observed that the calcium content of *Cassia tora i.e.* (Tarwad) leaves powder packaged in 100 gauge polythene bag was found to be 3.57, 3.58 and 3.53 (g/100g) at the storage period of 60, 120 and 180 days, respectively for powder packaged in 200 gauge polythene bag, it was found to be 3.56, 3.46 and 3.69 (g/100g) at the storage period of 60, 120 and 180 days, respectively and for powder packaged in 300 gauge polythene bag, it was found to be 3.56, 3.55 and 3.52 (g/100g) at the storage period of 60, 120 and 180 days, respectively. Results indicate that calcium content decreased during storage. Highest calcium content was observed for the powder packaged in 300 gauge polythene bag. Similar results for calcium were reported by Kubmarawa *et al.* (2011).

Effect of storage on fat content of *Cassia tora* leaves powder:

From Table 3 it is observed that the fat content of *Cassia tora i.e.* (Tarwad) leaves powder packaged in 100 gauge polythene bag was found to be 2.03, 2.03 and 2.00 (g/100g) at the storage period of 60, 120 and 180 days, respectively for powder packaged in 200 gauge polythene bag, it was found to be 2.02, 2.00 and 1.98 (g/100g) at the storage period of 60, 120 and 180 days, respectively and for powder packaged in 300 gauge polythene bag, it was found to be 2.07, 1.96 and 0.06 (g/100g) at the storage period of 60, 120 and 180 days, respectively. From above results it is concluded that fat content was decreased during storage. Highest fat content was observed for the powder packaged in 300 gauge polythene bag. Similar results for calcium were obtained by Kubmarawa *et al.* (2011).

All the treatments of packaging showed non-significant effect of storage on fibre and calcium where as little effect on fat content of the powder. Powder stored for a period of 60, 120 and 180 days showed little effect on fibre, calcium and fat content and treatment interaction also showed non-significant effect on the constituents.

Summary and conclusion:

Cassia tora green leaves consists of very good amount of nutritional composition. Although rich in nutrients, minerals and vitamins, itis available for a short period and highly perishable in nature having very low shelf-life. On the other side *Cassia tora* leaves are neglected or treated as weed and not commonly used as vegetable. Many deficiency diseases and poor nutritional diet problems are there in India. By using these leaves as vegetable in diet, health benefits can be harvested up to some extent. Hence, an investigation was undertaken to study the physico-chemical properties of *Cassia tora* L. From the data obtained and analyzed following conclusion was drawn.

– Drying of tarwad leaves can be doneat 60°C to obtain good quality powder:

– Packaging of 300 gauge polythene bag is the best to retain good quality of *Cassia tora* powder upto 180 days storage at room temperature.

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REFERENCES

Ansari, A. and Bhot, M. (2017). Evaluation of phytochemicals of *Cassia tora* L. and it's cytotoxicity assay using brine shrimp. *Internat. J. Pharmacognosy & Phytochemical Research*, **9** (4) : 587-595. DOI number: 10.25258/phyto.v9i2.8132.

AOAC (1992) *Official methods of analysis*. 11th Ed. Washington, DC: Association of Official Analytical Chemists.

Choudhary, M., Yuvraj, G. and Nitesh (2011). *Cassia tora*: It's chemical, medical uses and pharmacology. *Inst. Pharm. Sci. Kuruk. Univ.,* **3** : 78-96.

Dubey, R.B. and Sawant, B.S. (2015). Phermacognostic study of *Cassia tora* L. *J. Pharm.Sci.Innov.*, **4** (4): DOI:10.7897/2277-4572.04446.

Fathalla, N., Bishr, M., Singab, A. and Salama, O. (2015). Phytochemical and biological evaluation of *Cassia tora*, L. seeds. *J.Pharmacy & Bio. Sci.*, **10** (1) : 01-08.

Kubmarawa, D., Magomya, A.M., Yebpella, G.G. and Adedayo, S.A. (2011). Nutrient content and amino acid composition of the leaves of *Cassia tora* and *Celtisintegrifolia*. *Int. Res J. Biochem & Bioinformatics*, **1**(9):222-225.

Nandi, B. K. and Bhattacharjee, S. (2013). The case study on indigeneous food and nutrition security in India, National Institute of Nutrition. ICMR. Hyderabad-500 007, India.

Panse, V. G. and Sukhatme, P. V. (1957). *Statistical methods for agricultural workers.* A Book Published by ICAR, New Delhi: 1-357pp.

Pawar, H.A. and D'mello, P. M. (2011). *Cassia tora* L.: An overview. *Int. J. Pharmacological Sci. & Res.*, **2**(9): 2286-2291.

Premavalli, K.S., Majumdar, T.K. and Madhura, C.V. (2001). Processing effect of on colour and vitamins of green leafy vegetables. *J.Food Sci. & Technol.*,**38**(1):79-81.

Rao, M. and Chattrerjee, B. (2016). Preliminary phytochemical, antioxidant and antimicrobial activities of different extracts of *cassia tora* and *Trichodesma indicum*. *Int. J. Pharmacy & Technology*, **8** (2) : 12578-12597.

Shaikh, R. and Syed, I. (2015). Proximate and phytochemical analysis of *Cassia tora* leaves. *J. Res. Pharmaceutical Sci*., **2** (8): 01-03.

Singh, G., Kawatra, A.,Sehgal, S. and Pragati (2003). Effect of storage on nutritional composition of selected dehydrated green leafy vegetable powders. *Plant Foodsfor Human Nutrition*, **58** : 1-9.

Singh, H., Bawa, A.S. and Ahmed, J. (1997). Dehydration characteristics of green leafy vegetables. *Indian Food Packer*, **51** (2): 5-13.

Singh, U., Sagar, V. R., Behera, T. K. and Kumar, S. P. (2006). Effect of drying conditions on the quality of dehydrated selected leafy vegetables. *J. Food Sci. & Technol.*, **43**(6) : 579 - 582.

Sui-Ming, Wong, Mary, Moy, Wong, Otto, Seligmann and Hildebert, Wagner (1989). Anthraquinone glycosides from the seeds of *Cassia tora? Phytochemistry*, **28** (1) : 211-214.

Supare, S. and Patil, M. (2011). Estimation of phytochemical components from *Cassia tora* and to study its larvicidal activity. *Int. J. Pharmaceutical Science Invention*, **4** (6) : 11-16.

Veerachari, U. and Bopaiah, A. (2012). Phytochemical investigation of the ethanol, methanol and ethyl acetate leaf extracts of six cassia species. *Internat. J. Pharma & Bio Sci.*, **3** (2): 260 - 270.

Wealth of India (1992). A dictionary of Indian Raw materials and Industrial products- Raw mat, Pub & Info., Directorate, CSIR, New Delhi. *Revised Ser.*, **3** (ca-ci):103-107.