Traditional medicaments through papaya in North eastern plains zone of India

PL Saran\(^1\), R Choudhary\(^1\), IS Solanki\(^1\) & G Devi\(^2\)

\(^1\)Indian Agricultural Research Institute Regional Station, Pusa-848 125, Samastipur, Bihar, India;\(^2\)Anand Agricultural University, Anand-389 151, Gujarat, India

\*E-mail: plsdehradun@gmail.com

Received 30 September, revised 15 January 2015

Information and knowledge were collected for the first time through questionnaire and interviews on medicinal aspects. Each part of papaya plant is useful in one way or another; from its fruit to its stem and leaves. Different parts of papaya, viz. fruits (ripe and unripe), seeds, bark, leaves, roots and latex are used for treatment of several diseases like, jaundice, stomach problem, dengue, ringworm, roundworm, wound dressing, urinary complaint, anti-hemolytic activity, weight loss, high blood pressure, snake bite to remove poison and abortion. Among different diseases, farmers put jaundice (94.96%) and stomach problems (87.66%) at rank I, and dengue (67.38%) at rank II. Farmers between 46-60 yrs age group possess more traditional knowledge (91.70%) about the medicament properties of papaya parts. The knowledge level increases with the increase in age. Traditional knowledge of labourers and farmers of NEPZ regarding medicinal uses of different parts of papaya for management of dengue fever and jaundice diseases supported along with medical treatment by papaya leaf and fruit extract increase the PLT and RBC, respectively. Papaya fruit enhancing the hydrocele problem might be due to some anti-nutrients toxicannts and cooling effect on human body.

**Keywords:** Papaya, Medicinal properties, Diseases, Hydrocele

**IPC Int. Cl.\(^3\):** A61K 36/00, A01D 7/31, A01D 7/00, A01D 20/12, A01D 10/00

Horticultural plants including fruits and vegetables have long been valued as part of a nutritious and tasty diet. The flavours provided by different fruit species are among the most preferred in the world, and it is increasingly evident that fruits not only taste good, but also good for human health. It is well established that horticultural plants and products are in general used in traditional medicaments and a rich source of vitamins, organic acids, sugars, phenolics, minerals and dietary fibre (non-starch polysaccharides) that are essential for normal growth and development and overall nutritional well-being\(^1,2\).

Papaya (*Carica papaya* L.) is the sole species of the genus *Carica* of Caricaceae family with a somatic chromosome number, 2n = 2x = 18, includes six genera with at least 35 species. Caricaceae, consisting of four genera: (1) *Carica* with 22 species, (2) *Jacaratia* with 6 species, (3) *Jarilla* with 1 species and (4) *Cylcomomorpha* with 2 species. The first three are indigenous to tropical America and the last one to equitorial Africa. Species having edible fruits are found only in *Carica*. Besides *C. papaya*, they are *C. chilensis*, *C. goudotiana*, *C. monoica*, and *C. pubescens*. It is a perennial evergreen horticultural plant, which has a short growth period and of great nutritive and healthcare values\(^4\).

Further research and exploitation of high added-value products from papaya will benefit the development of papaya industry. It has gained more importance owing to its high palatability, fruitability throughout the year, early fruiting, highest productivity per unit area and multifarious uses like food, medicine and industrial input. Papaya is regarded as an excellent source of vitamin C (ascorbic acid); a good source of carotene, riboflavin and a fair source of iron, calcium, thiamin, niacin, pantothenic acid, vitamin B-6 and vitamin K\(^5\).

Carotenoid content (13.80 mg/100 gm dry pulp) of papaya is low compared to mango (50-260 mg/100 gm dry pulp). The major carotenoid is cryptoxanthin which is responsible for the flesh colour of papaya fruit mesocarp\(^6\). The total lipid content in ripe papaya fruit varies from 0.92 to 2.2 gm/100 gm dry matter. Palmitic acid and linolenic acid are two major fatty acids in papaya. The major components of papaya dry matter are carbohydrates\(^7\). There are two main types of carbohydrates in papaya fruits, the cell wall polysaccharides and soluble sugars. The papaya
leaves, bark, root, seed and latex may be used for
several purposes. The fruits are consumed at unripe and
ripe stages in different parts of India. The papaya
pomace, skins, leaves, and other by-products of papaya
processing may find use in animal feed applications.

In folk medicine, latex is used for treatment of
several diseases due to antibiotic, allergic, anti-
nutritional and toxic properties. Untested herbal
medicines could be potentially injurious to human
health. Many plants used in traditional and folk
medicines are potentially toxic, mutagenic, and
carcinogenic. Dengue is a common pathogenic
disease often proving fatal, more commonly affecting
the people in tropical and subtropical areas. Aedes
mosquito is the vector for this disease, and outbreaks
of dengue often cause endemic damage to life.
Traditional medicine offers an alternative solution and
could be explored as a safer treatment option. Jaundice
and hydrocele are significant cause of morbidity and mortality and lead to adverse effects on
human inhabitants in North Eastern Plains Zone
(NEPZ) of India.

Various records on the traditional knowledge of
papaya are reported but no more previous records are
available on jaundice and hydrocele problem. Therefore, keeping above facts in the mind, the
present study comprises the documentation of medicinal uses of papaya for diseases management by
the tribal’s and cultivators.

Methodology
The present investigation was carried out during
2012-2014 at Indian Agricultural Research Institute
Regional Station, Pusa, Samastipur (Bihar). The
farmers of different tribes from North Eastern Plains
Zone, viz. Lakhera, Santhal, Munda, Ho, Uraon, etc.,
including other papaya cultivators were interacted
during their visits at our centre for the purchase of
seeds and planting material of the crop round the year.
Eight hundred farmers interacted during study period.
The interviewed cultivators and tribals were ≤ 30 (105
and 95, respectively), 31-45 (219 and 81, respectively)
and 46-60 (240 and 60, respectively) yrs old.

The data were collected by using both interaction
and participatory rural appraisal (PRA) techniques.
The investigation included individual and group
interviews with the respondent farmers (Fig. 1). PRA
techniques namely, talk and semi-structured
interviews were conducted with the farmer groups of
each of the selected tribes. The mission of identifying
the indigenous practices was accomplished with the
help of check list of questions put during the
interaction and interviews. After locating the
indigenous practices, a check list of 12 diseases/
disorders was prepared. The data was also
congregated on various aspects such as method of
preparation and medicinal use of the papaya parts.

The per cent of each rank was thus converted into
scores. Then, for each problem, the score of individual farmers were added and divided by the
total number of farmers. The mean score for all the
values were arranged in ascending order to obtain the
rankings. To measure the degree of medicinal value as
experienced by the farmers in relation to papaya parts
used for disease management, the respondents were
asked to indicate on a major twelve diseases
continuum about the extent to which each disease was
perceived as crucial factor.

Case study
Dengue fever
Twelve patients with symptoms of fever were
selected from Government hospital, Pusa, Samastipur,
Bihar, India. On investigation, patients were found to
be dengue IgM antibodies positive and had average platelets counts between $58 \times 10^3/\mu l$ to $62 \times 10^3/\mu l$. Four patients of the control group were treated with only medical management and 4 patients in the study group were administered 50 ml of papaya fruit extract in addition to medical management randomly. Rest 4 patients in the study group were administered 20 ml of papaya leaf extract in addition to medical management. Papaya fruit and leaf extract was administered before food, once a day for four consecutive days with sugar to avoid bitterness and better palatability. Every day in the morning fresh papaya mature leaves and unripe fruits (90-100 days old) were collected (Fig. 2), thoroughly washed by water and wiped with sterile cotton cloth. The leaves were crushed with mortar pestle without adding water. The fruits without seeds were crushed in juice mixer. The pastes were kept in muslin cloth. After squeezing, the filtrate was collected and stored in a container. All aseptic measures were taken care of while preparing the extract. Leaves and fruits were picked daily for the same. During the course of leaf and fruit extract administration, platelet counts were recorded from hospital.

Hydrocele
A total of 383 respondents were surveyed for hydrocele disease. We offered the ripe papaya fruits to all the respondents during seed crop harvesting season (December to March) and observed the response from the respondents for their liking and disliking. The investigation included individual and group interviews with the respondent farmers with the help of questionnaire. After locating the indigenous practices, the percent of hydrocele patients were recorded.

Statistical analysis
The statistical analysis of the data was carried out using Duncan’s multiple range test (DMRT) at the $P < 0.05$ level of probability to test the differences between the treatment means using SPSS software. All the data were analysed using one-way ANOVA.

Results and discussion
The nutritional and medicinal properties of different parts of papaya were quarried from farmers and tribals in different age groups. Fruits are consumed at unripe and ripe stages. The edible portion of fruit contains macro-minerals (sodium, potassium, calcium, magnesium and phosphorus), micro-minerals (iron, copper, zinc, manganese and selenium), protein, fat, fiber, carbohydrates, vitamin-C, thiamine, riboflavin, niacin, carotene, amino acids, citric acid, malic acid, palmitic acid, linolenic acid, glucose, fructose, and sucrose.

Unripe papaya is never eaten raw because of its latex content. Raw green papaya is frequently used for cooking, in salads, making sweets like Petha, namkeen like Ganthia (Gujarati dish) and used for vegetable. The preserved unripe papaya fruit, which contains high sugar content, is used as an additive in ice cream. Half ripe fruits are sliced and crystallized as a sweet meat for consumption. Ripe fruits are most commonly eaten fresh, merely peeled, seeds removed, cut in wedges and served with a half or quarter of lime or lemon. Powdered or dried papaya can be used as a flavoring agent, meat tenderizer or as an ingredient in soup mixes. Similarly, unripe fruits are utilized as vegetables, processed products and as a source of papain. Unripe and ripe fruits were very popular among farmers for management of several diseases like, stomachic, digestive, carminative, diuretic, dysentery and chronic diarrhea, expectorant, sedative and tonic, relieves obesity, bleeding piles, wound of urinary tract, ringworm and skin disease psoriasis. Excess use of fruits causes diarrhea, cold and increase the pain in

Fig. 2— Interaction with papaya cultivators for information regarding traditional medicaments
hydrocele patients (common disease in NEPZ). Normal consumption of ripe papaya during pregnancy may not be dangerous; however, unripe or semi-ripe papaya (which contains high amount of latex that produces marked uterine contraction) could be unsafe for consumption during pregnancy. Similarly, harmful effect of unripe fruits in pregnant ladies due to excess use was reported\textsuperscript{14}.

Survey reflects that seeds are sometimes used to adulterate whole black pepper. Dried seeds with honey showed significant effect on human intestinal parasites without significant side effects. Seed paste also being used in the treatment of ringworm, psoriasis and antihelmintic agent due to predominantly attributed to carpaine and carpasemine (benzyl thiourea). Anti-fertility, anti-implantation and abortifacient properties of seed extract were also reported\textsuperscript{15}. Sometimes, a few seeds are left attached for those who enjoy their peppery flavor but not many should be eaten because the seed extract of papaya causes sterility in mammals. It has been established in males that the seeds of \textit{C. papaya} are potential anti-fertility drugs\textsuperscript{16}. Excess use of seeds causes bleeding in piles, enlarge liver, anti-fertility, anti-implantation and abortifacient properties due to damaging the endometrium, making the uterus non-receptive and, thus, affecting adversely the implantation by BITC; the main bioactive compound in \textit{C. papaya} seeds has been shown to be responsible for the anti-fertility effect\textsuperscript{17}. The pulp has more BG before the maturation of papaya and it nearly disappeared after papaya matured, while the seed contains BG at every stage. BG can be hydrolyzed into benzyl isothiocyanate (BITC), a compound which has cancer preventive and anti-cancer activities\textsuperscript{4}.

Recently matured leaf extract may be used for improving the platelets count in dengue patients. Fine paste of leaves is used for jaundice, urinary complaints, gonorrhea (infusion) and wound dressing due to antibacterial and antifungal properties. Young leaves are cooked and eaten like spinach in the East Indies. Mature leaves are bitter and must be boiled with a change of water to eliminate much of the bitterness. Carpaine, an alkaloid found in papaya leaves, has also been used for medicinal purposes\textsuperscript{18}. Crushed leaves may be used to tenderize meat; however, stomach trouble, purgative effects and abortion may result from consumption of the dried papaya leaves. Excess uses of leaf extract also causes heart and respiration diseases like, digitalis\textsuperscript{9}.

Root is useful as a diuretic, abortifacient, checking of irregular bleeding from the uterus and piles, antifungal activity, and help in tumors of the uterus\textsuperscript{9}. Root infusion is also used for syphilis. Excess use of the root causes the bleeding from the uterus, piles and antifungal activity due to carposide and myrosin. Bark is also a useful part of the papaya and has medicinal properties. It is useful for the management of jaundice, anti-hemolytic activity, inner bark of teeth and anti-fungal activity\textsuperscript{9}.

The latex may be used for softening of tongue, liver and kidneys of animals which are consumed quickly after cooking or utilized immediately in food or feed products, as they are highly perishable. It is also used in toothpastes, cosmetics and detergents as well as pharmaceutical preparations. It may act as an anesthetic, relieves dyspepsia, cures diarrhea, pain of burn, topical use, bleeding haemorrhoids, stomachic and whooping cough. Papaya latex is used in food processing to tenderize meat, clarify beer and juice, produce chewing gum, coagulate milk, prepare cereals, and produce pet food\textsuperscript{9}. Excess use of papain also causes allergens, protein break-down, stomach ulcer, skin burning, etc., due to allergic reactions through oral, respiratory or contact routes of exposure; the typical symptoms include bronchial asthma and rhinitis\textsuperscript{19}.

The diseases managed by the papaya farmers and/or tribes were ranked in the order of merit according to the opinion of the respondents and the results have been presented in Table 1. Among the

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Frequency of adopter farmers</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abortifaciant, anti-implantation (Abortion)</td>
<td>0.078\textsuperscript{b}</td>
<td>IV</td>
</tr>
<tr>
<td>Anti-hemolytic activity</td>
<td>22.51\textsuperscript{a}</td>
<td>IV</td>
</tr>
<tr>
<td>Dengue fever</td>
<td>67.38\textsuperscript{c}</td>
<td>II</td>
</tr>
<tr>
<td>High blood pressure (Heart patients)</td>
<td>02.21\textsuperscript{b}</td>
<td>IV</td>
</tr>
<tr>
<td>Jaundice</td>
<td>94.96\textsuperscript{a}</td>
<td>I</td>
</tr>
<tr>
<td>Ringworm</td>
<td>26.30\textsuperscript{d}</td>
<td>III</td>
</tr>
<tr>
<td>Roundworm</td>
<td>27.00\textsuperscript{e}</td>
<td>III</td>
</tr>
<tr>
<td>Snakebite to remove poison</td>
<td>01.22\textsuperscript{e}</td>
<td>IV</td>
</tr>
<tr>
<td>Stomach problems (Digestive, carminative, dysentery and chronic diarrhea)</td>
<td>87.66\textsuperscript{e}</td>
<td>II</td>
</tr>
<tr>
<td>Urinary complaints (Diuretic)</td>
<td>44.15\textsuperscript{d}</td>
<td>III</td>
</tr>
<tr>
<td>Weight loss</td>
<td>09.07\textsuperscript{e}</td>
<td>IV</td>
</tr>
<tr>
<td>Wound dressing</td>
<td>25.83\textsuperscript{d}</td>
<td>III</td>
</tr>
</tbody>
</table>

Note: Means with the same letter (superscript) in the columns showing not significantly difference (\(P = 0.05\)) based on Duncan Multiple Range Test.
management of several common diseases by the use of papaya parts, farmers ranked jaundice (mean score 94.96%) and stomach problems (mean score 87.66%) at rank I, followed by dengue fever (mean score 67.38%) at rank II. Other diseases/problems like, urinary complaint (44.15%), roundworm (27%), ringworm (26.30%), wound dressing (25.83%) ranked III and anti-hemolytic activity (22.51%), weight loss (9.07%), high blood pressure (2.21%), snakebite to remove poison (1.22%), abortifacient (0.78%) ranked IV. Jaundice, stomach problem and dengue are the major problems of this region. Similarly, different papaya parts are known to be analgesic, amoebicidic, antibacterial, cardiotonic, cholagogue, digestive, emenagogue, febrifuge, hypotensive, laxative, pectoral, stomachic and vermifugic.

Traditional knowledge regarding medicinal uses and management of several common diseases depends upon the age group of farmers and tribals. The data revealed that knowledge level of farmers/tribals increases with the increase in age. The farmers in the age group, 46-60 yrs have more knowledge (91.70%) about the medicinal properties of different parts of papaya, followed by the age group, 31-45 yrs (33.3%) and equal to or less than 30 yrs age group (16.70%) (Fig. 3). The trend line shows that the knowledge level increases with the increase in age of framers. Experienced people have more knowledge about the medicament properties. Similarly, age group between 45-86 yrs is more proactive in use of medicinal plants in management of diabetes-mellitus.

Case study

Dengue Fever

The dengue fever attack cases are reported from the onset of rainy season to early winter season in India, especially North Eastern Plains Zone. The dengue fever recurs every year and causes several deaths in this region. Twelve male patients working as labourers at farmers’ fields were brought to the hospital with sever fever of averaging 104°F. Supplement of papaya unripe fruit and leaf extract on platelet count for dengue patient as supportive therapy was given with medical treatment. Papaya leaf in the treatment of Dengue fever (DF) has also been reported. These patients were administrated medical treatment along with unripe fruit extract without seeds (50 ml/day/sample) and leaf extract (20 ml/day/sample). These extracts were administered to patients infected with dengue fever daily in morning for four consecutive days. Similarly, five days of oral administration of 25 ml aqueous extract of papaya leaves to the patient twice daily has been reported.

Before the extract administration, the blood samples from patients were analyzed. The initial average platelets count (PLT) in blood test ranged from 58 x 10^3/µl to 62 x 10^3/µl indicating the severity of disease. Average PLT increased from 61 x 10^3/µl to 170 x 10^3/µl in MT, 62 x 10^3/µl to 186 x 10^3/µl in MT + unripe fruit extract and 58 x 10^3/µl to 202 x 10^3/µl in case of MT + leaf extract as a supportive therapy (ST). The patient given medical treatment with oral feedings of fruit extract was statistically at par, while medical treatment with oral feedings of leaf extract was significantly effective against dengue fever as compared to other treatments (Table 2). The aqueous extract of leaves of this plant exhibited

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Platelet count</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial 1^st day 2^nd day 3^rd day 4^th day</td>
</tr>
<tr>
<td>Medical treatment</td>
<td>61 x10^3/µl 70 x10^3/µl 97 x10^3/µl 122 x10^3/µl 170 x10^3/µl</td>
</tr>
<tr>
<td>Fruit extract (ST)</td>
<td>62 x10^3/µl 74 x10^3/µl 110 x10^3/µl 130 x10^3/µl 186 x10^3/µl</td>
</tr>
<tr>
<td>Leaf extract (ST)</td>
<td>58 x10^3/µl 77 x10^3/µl 100 x10^3/µl 154 x10^3/µl 202 x10^3/µl</td>
</tr>
</tbody>
</table>

Note: Means with the same letter (superscript) in the columns showing platelets counts do not significantly different (P = 0.05) based on Duncan Multiple Range Test.

Fig. 3—Relationship between knowledge level and age of farmers regarding medicinal uses of papaya and its parts
potential activity against dengue fever by increasing the platelets (PLT) count.\textsuperscript{10,22} The bioactive anti-malaria element has important commercial potential since the fruit grows in abundance in the tropics.\textsuperscript{14}

**Jaundice**

All the patients were taking medical treatment (MT) from local hospital along with traditional medicaments, viz. unripe fruits (72), fruit latex (11), curd (19) and rasgulla sweet (18) as a supportive treatment of their choice. In all the treatments, MT + unripe fruit ranked I, followed by MT + fruit latex at rank II, MT + curd at rank III, MT + sweet (Rasgulla) at rank IV as supportive treatments and medical treatment as control at rank V with recovery durations of 24, 25, 28, 28 and 30 days, respectively. Among them MT + unripe fruit, followed by MT + fruit latex were significantly most effective for jaundice patients (Table 3). Many biologically active phytochemicals from different parts of papaya tree, viz. leaf, stem bark and flower have been isolated and studied for their potency against jaundice. Papaya leaves have also been used as treatment for genito-urinary ailments.\textsuperscript{9} The unripe fruit is also used traditionally for treating jaundice by the *Yoruba* tribe of Nigeria and tribals in India.\textsuperscript{23}

**Hydrocele**

A total of 383 farmers and farm labourers have visited IARI RS, Pusa (Samastipur) during 2013-14 for purchase of papaya seed. An average of 34.73% was affected by symptoms of hydrocele. Among them, farmers (32.80%) are comparatively less infected than the labourers (43.06%) by hydrocele problem (Fig. 4). All the farmers and labourers were offered ripe papaya fruit during winter harvesting after seed extraction for eating purpose. Approximately 68.67% patients preferred papaya eating; 70.74% farmers and 59.72% labourers (Table 4). The labourers are more susceptible due to lack of education and hygienic conditions. They have traditional knowledge that eating papaya fruits increase the pain in hydrocele patients. Peel and pulp of ripe papaya fruits contain low amounts of anti-nutritional factors like, tannin, phytate and oxalate creating incompatibility problems. The ripe fruits are also poor source of benzylglucosinolate (BG) and benzyl isothiocyanate (BITC) toxicants.\textsuperscript{4,9}

In conclusion, we observed that each part of papaya plant is used for treatment of several diseases. Papaya fruit is also enhancing the hydrocele problem might be due to source of some anti-nutrients, toxicants and cold effect. The delicious papaya fruit has nutritional values that make it potent raw material for drug industry beyond simple raw consumption. The knowledge level increases with the increase in age of tribes regarding medicaments.

**Conflict of interest statement**

We declare that we have no conflict of interest.

**References**