

Review Article

<https://doi.org/10.20546/ijcmas.2020.902.349>

Chironji (*Buchanania lanzan*) Wonder Tree: Nutritional and Therapeutic Values

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ABSTRACT

Chironji (*Buchanania lanzan* Spreng.) is a member of the family Anacardiaceae and it is originated in the Indian sub-continent, is an excellent multipurpose tree species. Traditional indigenous knowledge reveals the immense value of almost all parts of the plant i.e. roots, leaves, fruits, seeds and gum for various medicinal uses. Chironji (*Buchanania lanzan*) is an important non-wood tree species found in deciduous forests throughout the greater part of India. It is a multipurpose tree and very important plant for rural and tribal economy. It is used as a fuel, fodder, alternative host for *Kusmi* lac insect, and also used in cosmetic items and soaps. Seeds/ kernel are nutritional, palatable and used as a substitute of almonds in confectionery. It is widely used by Indian tribes for treating various diseases. Three major chemical constituents of potent medicinal value, namely celidoniol, vomicine, epinitol have been characterized from an organic extract of leaves. Such extracts mainly exhibit antidiabetic, anti hyperlipidemic, antioxidant, anti-inflammatory, wound healing, antidiarrheal, antivenom activity including a host of other curative properties. Very recently, unique biomaterials and biofilms are being extracted from seeds, which promise to become a major contributor in pharmaceutical industry. At present, it is growing under forest condition as an under exploited fruit and gives monetary reward to tribal community of the country. The tree is natural wild growth in the tropical deciduous forests of Northern, Western and Central India, mostly in the States of Chhattisgarh, Jharkhand, Madhya Pradesh and in Varanasi and Mirzapur districts and Bundelkhand region of Uttar Pradesh. *Chironji* is a vulnerable medicinal plant, is included in the Red Data Book published by International Union for Conservation of Nature and Natural Resources. In this background, there is compelling need for developing a suitable technology facilitating easy multiplication, regeneration and conservation of the species, simultaneously imparting and disseminating proper knowledge and education to the tribal population.

Keywords

Deciduous forests
tribal community
knowledge and
education

Article Info

Accepted:
20 January 2020
Available Online:
10 February 2020

Introduction

Chironji or Charoli, (*Buchanania lanzan* Spreng.), a member of the family Anacardiaceae, originated in the Indian sub-continent, is an excellent tree of agro forestry. It assumes great significance due to its multifarious uses and capacity to withstand adverse climatic conditions. At present, it is growing under forest condition as an under exploited fruit and gives monetary reward to tribal community of the country. It is a medium size tree, up to 40-50 ft. height with a straight trunk. Trees have the alternate bearing nature as present in the mango. It flowers in the month of January- February and ripen in April-May.

Its bark is rough, dark grey or black, fissured into prominent squares, 1.25 to 1.75 cm thick, and is reddish inside. Flowering starts in the month of November and its leaves are coriaceous, broadly oblong with a rounded base. It bears fruits, each containing a single seed known as “chironji” and is quite popular as an edible nut. It avoids waterlogged areas, but occurs on yellow sandy loam soils. Tree can be easily identified by its dark grey crocodile bark with red blaze and is a good species for afforestation in bare hill slopes. *Buchanania lanzan*, being a vulnerable medicinal plant, is included in the Red Data Book published by International Union for Conservation of Nature and Natural Resources (IUCN) (Kritikar and Basu, 1935).

Seven species of *Buchanania* have been reported in India of which two *B. lanzan* (Syn. *B. latifolia*) and *B. axillaries* (Syn. *angustifolia*) produce edible fruits. *B. lanceolata* is an endangered species. It is found in the ever green forests of Kerala. *B. platyneura* is found in Andaman only. Other species of the genus are *B. lucida*, *B. glabra*, *B.accuminata*. It is reported that the fruits of *B. platyneura* are also edible. The *B. exillaris*

are reported to be dwarf in size and produces excellent quality of kernel. (Chauhan *et al.*, 2012) . Among these species *Buchanania lanzan* Spreng is most important and widely distributed species in India. This species was first described by Mr. Hamilton, a forester in 1798 in Burma and the genus *Buchanania* was named after him. It was originated in the Indian sub continent, and is found in India, Burma, Nepal and few other countries (Chauhan *et al.*, 2012). *Buchanania lanzan* Spreng commonly known as “Cuddaph almond”, “Char”, “Chironji” or Pyar is a valuable tree species found in mixed dry deciduous forest throughout the greater part of India excluding eastern Himalayan forests and arid regions of north India. The species is native to India.

Socio-economic importance

Chironji is a source of income for tribal people of Chhattisgarh and other states It is backbone of their economy. A considerable reduction in the population of Chironji in the forest and non-forest areas has been recorded (Singh *et al.*, 2002) and facing a severe threat of extinction. Due to this, Chironji is categorized under the 195 red listed medicinal plant species of Indian origin, that requires conservation measures as reported by Foundation of Revitalization of Local Health Tradition (FRLHT), Environmental Information System (ENVIS) - Centre on Medicinal Plants, Bangalore, Govt. of India.

Fresh fruit are eaten raw having pleasant, sweetish, sub-acid flavor and consumed by local people and also sold in the village market. Chironji is mainly regarded for its costly, high-priced kernels. These kernels has almond like flavor, eaten raw or roasted form, used as cooking spice and dry fruit in sweets, kheer, meaty korma in India. All parts of this plant root, leaves, gum, bark and fruits have various medicinal applications. Chironji seeds

are rich in nutrients and medicinal properties. Chironji is an active source of phenolics, natural antioxidants, fatty acids and minerals. Its seed oil is used to treat skin diseases, remove spots and blemishes from the face. Ethanolic and methanolic extract of Chironji roots has shown good anti-diarrheal activity and significant wound healing activity, respectively (Khatoon *et al.*, 2015).

Soil and climate

Chironji is very hardy plant and thrives well on rocky and gravelly red soils. Through it is very hardy tree but plants do not survive under waterlogged conditions. Well drain deep loam soil is ideal. It prefers tropical and subtropical climate and can withstand drought admirably. Chhattisgarh State is rich in forest wealth and 44.2 per cent of its geographical area is covered with forest (Anon., 2015).

Conservation methods adapted for Chironji

As far as conservation of genetic diversity of Chironji is concerned, both *in-situ* and *ex-situ* approaches should be used. In the present scenario, most appropriate strategy for Chironji germplasm conservation is to adopt immediate *ex-situ* conservation (i.e. field genebank and cryobanking) complemented with *in-situ* conservation (*In-situ* on-farm conservation and in protected areas such as National Parks) for this species. *Ex-situ* field genebanks are presently being established at horticulture research institutes of Indian Council of Agricultural Research at Godhra, Gujarat and Lucknow, Uttar Pradesh for conservation and developing advance propagation methods. Collected germplasm has been cryostored as base collection representing sizable diversity in the form of 127 accessions in the National Cryogene bank at NBPGR, New Delhi for posterity and future utilization (Malik *et al.*, 2012).

In-vitro propagation

Sharma *et al.*, (2005) developed a protocol for somatic embryogenesis and plantlet regeneration of Chironji (*Buchanania lanzan*) by immature zygotic embryos cultured on Murashige and Skoog (MS) medium supplemented with various combinations of 2,4 dichlorophenoxy acetic acid (2,4-D), 6-benzyladenine (BA) and/or 1-naphthalene acetic acid (NAA). The highest frequency (60%) of somatic embryo induction was obtained in cultures grown on MS medium fortified with 4.53 μM 2,4-D, 5.32 μM NAA and 4.48 μM BA. The medium supplemented with 15 μM abscisic acid (ABA) was most effective for maturation and germination of somatic embryos. Shende and Rai (2005) claimed to develop a tissue culture technique for the rapid clonal multiplication of Chironji. They reported multiple shoot initiation in decoated seeds cultured on MS medium enriched with various concentrations of auxins and cytokinins alone or in combination. Murashige-Skoog (MS) medium supplemented with 22.2 μM of BAP and 5.37 μM of NAA promoted formation of the maximum number of shoots.

Furthermore, MS medium containing 23.3 μM kinetin induced profuse rooting of the initiated shoots. Niratker (2016) studied *in-vitro* multiple shoot induction from shoot tips and nodal segments explants of Chironji in half strength MS medium supplemented with 1 mg/l BAP and 0.5 mg/l IAA with an average number of 3-4 shoots per explants. The most commonly used tissue explants are the meristematic ends of the plants such as the stem tip, auxiliary bud tip, and root tip. These tissues have high rates of cell division and either concentrate or produce the required growth-regulating substances including auxins and cytokinins (Akin Idowu *et al.*, 2009).

Vegetative propagation

Vegetative propagation methods like chip budding and softwood grafting (Singh and Singh, 2014) are also standardized and reported in Chironji. But these are less effective due to loss availability of rootstocks and dependency on seasonal conditions. Moreover, propagation through root cutting is a very slow process (Singh *et al.*, 2002). Srivastava (1996) reported that the tree is propagated from seeds which remain enclosed inside a hard shell. To get better germination, the shell of the fruit should be cracked carefully, he added. He further reported that fresh seeds give better germination and by using such seeds he observed 70 % germination. Choubey *et al.*, (1997) reported that best germination observed with 1 per cent HgCl treatment in chironji.

Vegetative propagation through soft wood grafting and chip budding was successful but rarely tried as no demand of plants has been generated in want of commercial cultivation, they reported. Shukla *et al.*, (1999) reported that 48-hour seed soaking in ordinary water gave as high as 71 per cent seed germination. On the other hand, mechanical breaking of stony endocarp resulted in 83 percent germination. However, they mentioned that mechanical breaking is time consuming and posse's high risk of damage to embryo. They also reported that seed can be stored in air tight containers up to one year.

Ethnomedicinal importance

The tribal people often consume and sale the highly nutritious seeds to sustain and also to earn their livelihood. The seeds possess 3.0% moisture and are rich in lipid/fat (59.0%), protein (19.0-21.6%), starch/carbohydrate (12.1%), fibre (3.8%), minerals such as calcium (279.0 mg), phosphorus (528.0 mg), iron (8.5 mg) and vitamins such as thiamine

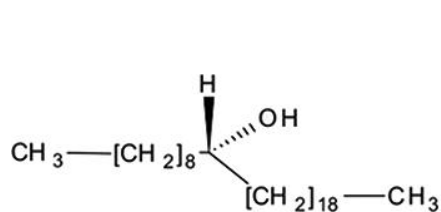
(0.69 mg), ascorbic acid/vitamin C (5.0 mg), riboflavin (0.53 mg), niacin (1.50 mg) and also contain 34-47% fatty oil. The seeds are also used as expectorant and tonic. The oil extracted from kernels is applied on skin diseases and also used to remove spots and blemishes from the face. The root is used as expectorant, in biliousness and also for curing blood diseases. The juice of the leaves is digestive, expectorant, aphrodisiac, and purgative. The gum after mixing with goat milk is used as an analgesic (singh., *et al.*, 2002). Seed collection should be done from 2nd to 3rd week of May for quality seed collection with respect to fruit weight, kernel weight, germination percent, and chemical content i.e. oil, protein and sugar contents. Destructive harvesting could be checked by educating forest tribal population about collection of ripe fruits at proper time i.e. from 2nd to 3rd week of May without damaging the trees by organized collection (Choubey, 1997).

Phytochemical profile

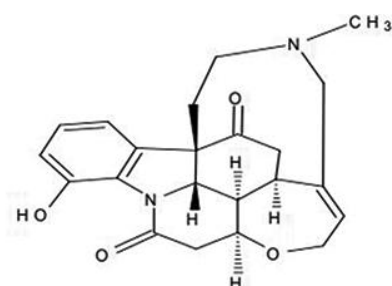
This plant like many other forest plants is storehouse of important unknown phyto-medicines. Till now sporadic reports have been published that reveals that specially leaf, bark, and seed are the major source of various important metabolites of great pharmaceutical value. Of late, researchers are focusing their attention on various forest plants including Chironji. The leaves are reported to contain tannins, triterpenoids, saponins, flavonoids, kaempferol-7-o'glucosides, quercetin-3-rahmnoglucoside, quercetin, gallic acid, kaemferol, and reducing sugars, including a new glycoside, and myricetin-3'-rhmnoside-3-galactoside (Nasim *et al.*, 1992; Mehta *et al.*, 2010). The bark contains tannins, alkaloids, and saponins. The seed and seed oil contains fibres, carbohydrates, mineral, fats, vitamin B1, B2, B3, C, calcium, chlorine copper, iron, magnesium, phosphorus,,

potassium, sodium, sulfur, fatty oil, β -amyrin (Khare., 2007) . The fatty acid composition of *B. lanzan* seed oil, determined by urea complex formation and gas liquid chromatography is found to contain following: Myristic, 0.6%; palmitic, 33.4%; stearic, 6.3%; oleic, 53.7%; and linoleic, 6.0%. Triglyceride compositions of the native seed oil and its randomised product are calculated from the fatty acid compositions of the triglycerides and of the corresponding 2-monoglycerides produced by pancreatic lipase hydrolysis.

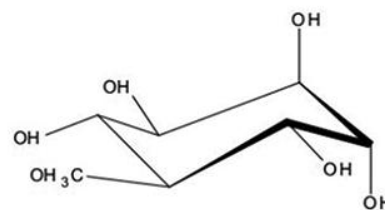
The oil is composed of 3.2%, 35.8%, 45.5%, and 15.5% tri-saturated, monounsaturated di-saturated, di-unsaturated mono-saturated and tri-unsaturated glycerides, respectively. The special characteristic of the *B. lanzan* seed oil is its content of 22.7%, 31.0%, and 11.3% dipalmitoolein, dioleopalmitin, and triolein. Three major chemical constituents isolated from the methanolic extract of leaves, characterized based on chemical tests and spectral analysis such as infrared, H nuclear magnetic resonance, mass spectroscopy were epinitol, vomicine, and celidoniol (Mehta *et al.*, 2011).



Celidoniol



Vomicine



Epinitol

Medicinal and curative properties

B. lanzan is a widely used plant with a history of traditional medicinal use for the treatment of various diseases. It is used in the form of decoction to treat intrinsic haemorrhage, diarrhoea with blood and as tonic. Grown up child who has left the breast milk should be given sweet bolus prepared of *B. lanzan* kernels, madhuka (*Glycyrrhiza glabra*) honey, parched paddy and sugar candy. Kernels made into a powder and used with milk as aphrodisiac and in case of fever and burning sensation.

Powder of the bark mixed with honey is useful in blood dysentery. This plant has a long history of folk use in tribal societies across tropical regions of the world. At present, in this era of herbal science, in depth research is being carried out in every such plants to discover pharmaceutically active

novel magic drugs. In this review, we tried to project a comprehensive account of the global effort already undertaken to explore the phytochemical wealth of *B. lanzan*.

Anti-inflammatory and analgesic activities

Inflammation is considered as a primary physiologic defence mechanism that helps body to protect itself against infection, burn, toxic chemicals, allergens, or other noxious stimuli. The *in vivo* anti-inflammatory activity is evaluated in rats by using carrageenan-induced paw edema, as an acute model and formaldehyde induced arthritis as a chronic model. The methanolic extract of *B. lanzan* kernel (200 mg/kg body wt) significantly decreased paw volume, after oral administration of the extract (Duragkar and Bhusari., 2010). The methanolic extract of the leaves of *B.lanzan* at different doses used showed good anti-inflammatory activity,

which has been done significantly, by the formation of oedema induced by carrageenan. These results are also comparable to aspirin, the reference drugs used in this study. It indicates the efficacy of the methanolic extract as a therapeutic agent in acute as well as chronic inflammatory conditions (Mehta *et al.*, 2011).

Antioxidant activity

Antioxidants help to deal with oxidative stress which is caused by free radical damage. *In vitro* antioxidant activity is performed on methanolic extract of *B. lanzan* kernel by 1, 1-diphenyl-2-picryl-hydrazyl (DPPH) and reducing power method. Quantitative estimation of total polyphenolic content of the extract is estimated by Folin-Ciocalteu method. The extract exhibits significant antioxidant activity. The *in vitro* antioxidant activity of phenolic compounds in the methanol and acetone extract of *B. lanzan* root is established. Both extract shows good degree of electron donation capacity in terms of relative reductive efficiency (RRE), but methanolic extract shows more RRE (0.79) value as compared to acetone extract (0.60) due to more content of phenolics. In cyclic voltammetry measurement lower oxidation potential of methanol extract shows higher antioxidant efficacy. In DPPH system, the strongest radical scavenging activity was exhibited by the methanolic extract (EC50 = 0.24±0.02) (Pareta *et al.*, 2011).

Antidiabetic and antihyperlipidemic activity

Diabetes mellitus is a chronic metabolic disease caused by an absolute or relative lack of insulin and or reduced insulin activity. Hyperlipidemic condition is metabolic complication of both clinical and experimental diabetes (Gandhi., 2001). Low density lipoprotein in diabetic patients leads

to abnormal metabolism and is associated with increase in very low density lipoprotein (VLDL) secretion and impaired VLDL catabolism. Ultimately, this leads to atherosclerotic plaque formation (Kameshra *et al.*, 2001). Those with blood glucose levels >190±8 mg/dl are administered the methanolic leaf extract of *B. lanzan* (100 or 200 mg/kg, body weight) or positive control for 21 days. Blood glucose and lipid profile are evaluated.

Adaptogenic activity

Adaptogens cause an adaptive reaction to a disease and are useful in many unrelated illness and appear to produce a state of non-specific increased resistance during stress resulting in stress protection (Alexander and Wickman 2010). The methanolic extract of *B. lanzan* leaves are evaluated for adaptogenic activity using the swim endurance model in all groups under normal and stressed conditions. Urinary vanillyl mandelic acid (VMA) and ascorbic acid are selected as non-invasive biomarkers to evaluate the antistress activity. The 24 hrs urinary excretion of VMA and ascorbic acid are determined by spectrophotometric methods. Daily administration of the extract at doses of 10, 20, 30, 40 and 50 mg/kg body weight prior to induction of stress inhibited stress-induced urinary biochemical changes in a dose-dependent manner without altering the levels in normal control groups. The methanolic extract exhibited significant anti-stress activity (Mehta *et al.*, 2011).

Wound healing activity

The ethanolic extract of *B. lanzan* fruits was used in Albino rats for wound healing activity and used to study the effect in dexamethasone suppressed wound healing. Three wound models *viz.*, incision, excision and dead space wounds were used in this study. The

parameters studied are breaking strength in case of incision wounds, epithelialization and wound contraction in case of excision wound and granulation tissue dry weight, breaking strength and hydroxyproline content in case of dead space wound.

The dexamethasone treated group showed a significant ($p < 0.001$) reduction in the wound breaking strength when compared to control group in incision type of wound model. Co-administration of *B. lanzan* with dexamethasone significantly ($p < 0.001$) increased the breaking strength of dexamethasone treated group. *In-vivo* wound healing supporting study mediated by carrageenan induced paw edema as anti-inflammatory activity. Herbal gel was formulated incorporating one of the active ethyl acetate sub-fractions in two concentrations (1% and 5%). Gel was evaluated for its spreadability, pH, color, consistency and appearance. The 5% gel exhibited significant increase in percentage of wound contraction as well as growth in tensile strength with 177 g ($p < 0.05$) and 181.2 g ($p < 0.01$), respectively (Mehta *et al.*, 2014).

Memory booster

Alzheimer's disease is a progressive neurodegenerative brain disorder that occurs gradually and results in memory loss, unusual behavior, personality changes, and ultimately death (Reddy., 1997). Biochemical abnormalities such as reduction of acetyltransferase, acetylcholine biosyntheses and increase in acetyl cholinesterase (AChE), and metabolism are strongly associated the degree of cognitive impairment (Ellen., 1997). Petroleum ether extract of seeds of *B.lanzan* (PEB) (500 mg/kg, oral) is studied for its neuro-psychopharmacological effect in experimental rats.

Activity of seeds extract on memory acquisition and retention is studied using

elevated plus maze and step down apparatus models, and AChE enzyme level at discrete parts of brain is also estimated. Administration of PEB (500 mg/kg) to positive control and treated groups showed significant reduction in transfer latency in elevated plus maze, increase in step down latency in step down apparatus models and reduction of acetylcholine esterase enzyme activity in different regions of the brain as compared with the other groups (Neelkanth., 2011).

Antivenom activity

B. lanzan includes in the list of the plants which have anti-snake venom activity. Fruit and bark extract of *B. lanzan* is used for the treatment of snake bite in Chhattisgarh region (Minu *et al.*, 2012). The ethanolic extract of *B. lanzan* bark was studied against toxicity induced by *Naja kaouthia* snake venom by various *in vivo* and *in vitro* studies. The extract was evaluated for neutralization of lethality, myotoxicity, phospholipase A2 activity and human red blood cell lysis produced by *N. kaouthia* snake venom. The extract at 200 mg/kg and 400 mg/kg significantly neutralized the lethality produced at different concentration of snake venom.

Myotoxicity also decreased up to a significant level characterized by decline in creatine phosphokinase level. *In vitro* models for assessing hemolytic activity were found to be significantly decreased in the presence of the extract. Both direct and indirect hemolytic study was performed at various concentration of extract. More than 50% of hemolysis was significantly neutralized by the extract. Results showed significant neutralization of toxicity produced by *N. kaouthia* snake venom (Hedge *et al.*, 2014).

Value addition in chironji

Although the kernel has more economic value, the fruits of chironji also have potential to be processed into several value added products.

Fruits

The fruit of chironji is juicy and sweet in taste. Although the juice recovery is quite less due to large seed size, the fruit can be used for preparation of various value added products like squash, ready to serve (R.T.S.) drinks and nectar after juice extraction. Fruits can also be dried locally under sun or in cabinet drier under controlled conditions and can be preserved in the form of fruit powder. Moreover, fermented beverage *i.e.*, wine can also be prepared from the pulp of the fruits.

Chironji Nuts

Although chironji nuts and kernels have been used extensively but there is no machinery for processing of chironji nuts. The shelling of

chironji nuts is usually done manually and sometimes by locally made machines. This traditional process involves soaking the seeds in water for 24 hours, skin removal by hand rubbing followed by drying. Dried nut is broken by rubbing between a pair of stone slab or hammer followed by separation of kernel from the hull (Kumar *et al.*, 2012). The chironji nuts are then packed either in glass jars or polyethylene bags. Chironji nuts are used in preparation of many sweet preparations such as halwa, kheer, laddu, paak *etc.* They are also used as dry fruit in preparation of sweets.

Chironji Oil

Chironji kernel contains about 52% oil (Kumar *et al.*, 2012). The kernel is used for extraction of chironji oil. This extracted oil is used mostly in cosmetic manufacturing and substitute for olive and almond oils (Siddiqui *et al.*, 2014). Sometimes this oil is also used by native people as edible oil.

Table.1 Proximate and mineral analysis of seeds of *Buchanania lanzan* (g/100g)

S. No.	Components	Proximal value (%)
1.	Ash	2.20
2.	Moisture	3.6
3.	Crude Fat	38
4.	Total Protein	43.24
5.	Total Carbohydrate	12.96
6.	Total Crude fiber	18.50
7.	Energy value (k cal)	229.99
8.	Phosphorus	593
9.	Strontium	0.68
10.	Zinc	3.32
11.	Aluminum	0.3
12.	Boron	0.6
13.	Calcium	70
14.	Cooper	1.15
15.	Iron	4.8
16.	Magnesium	275

Khatoon *et al.*, 2015

Table.2 Compound study in different solvent present in *Buchanania lanzan*

S.No.	Solvent	Compound Detected
1.	Petroleum ether	Oleic Acid
		Tetradecanoic Acid
		9-Octadecenamide
		β-Sitosterol
		9-Octadecenoic Acid
2.	Dichloromethane	Tetradecanoic acid
		n-Hexadecanoic acid
		γ-Sitosterol
		Oleic Acid
		Octadec-9-enoic acid
3.	Methanolic	Pentadecanoic acid, 14-methyl-, methyl ester
		Eicosanoic acid
		Phenol, 2-(1-phenylethyl)
		Oleic acid, 3-hydroxypropyl ester
		n-Hexadecanoic acid
4.	Ethanol-Water	Phenol, 2, 4-bi's (1,1-dimetyletyl)
		Tetradecanoic Acid
		2,6-Octadienal, 3,7-dimethyi
		Octadecanoic acid
		Octadecanoic acid, 2,3-dihydroxypropyl ester

Khatoon *et al.*, 2015

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How to cite this article:

Neeraj, Vinita Bisht, Shalini Purwar. 2020. Chironji (*Buchanania lanzan*) Wonder Tree: Nutritional and Therapeutic Values. *Int.J.Curr.Microbiol.App.Sci.* 9(02): 3033-3042. doi: <https://doi.org/10.20546/ijcmas.2020.902.349>