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## **HEVEA BRASILIENSIS: A CONCISE REVIEW**

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### **ABSTRACT**

*Hevea brasiliensis*, a rubber tree or rubber plant, is a flowering plant of the Euphorbiaceae family Spurge. Traditionally *Hevea brasiliensis* used as an anti-inflammatory, analgesic, treatment of muscle and joint pain. This review paper aims to highlight some of the medicinal values, edible uses, species, cultivation and growth stages of *Hevea brasiliensis*. Milky rubber extracted from the tree is the number one source of herbal rubber so it's far the maximum economically essential member of the *Hevea* species. *Hevea brasiliensis* is a species of rubber timber. These trees are usually discovered in low-altitude wet forests, wetlands, riparian zones, wooded area gaps, and disturbed regions. Natural rubber or latex from the *Hevea brasiliensis* is an essential commodity in diverse financial sectors in modern present day society. Proteins had been detected in latex since the early twentieth century, and they're recognized to adjust numerous organic pathways in the *Hevea Brasiliensis* trees including the natural rubber biosynthesis, defence against pathogens, wound recovery, and stress tolerance. Rubber seed, both as feed or meals, is a beneficial raw material to provide fit to be eaten oil and protein. Despite the large amount of rubber seeds produced in the northeast and their potential as a protein source, rubber seeds appear to be overlooked and underutilised as feed/meals due to the perception

that they are inedible and dangerous due to high levels of cyanogenic glycoside. As a result, the search for effective processing technique(s) to improve its food usage application may be extremely appropriate.

**Keywords:** *Hevea brasiliensis*, latex, phytochemicals, rubber seeds, edible use

## INTRODUCTION

The rubber tree, *Hevea brasiliensis* (H. Brasiliensis), is the most common source of natural rubber. Rubber is made from a plant called *Hevea brasiliensis*, which belongs to the Euphorbiaceae family. *Hevea brasiliensis* is usually straight or tapering, branchless for 10 m or more, with at least 50 cm diameter and no buttresses; bark surface smooth, hoop marked, grey to faded brown, inner bark pale brown, with abundant white latex; crown conical, branches thin [1].

Several rubber generating international locations are expanding cultivation of rubber to regions outdoor the scope of most appropriate climate situations to meet increasing demand for natural rubber, capture otherwise 'waste' land, decorate financial activities of rural dwellers and increase of export change to earn foreign exchange [2].

Rubber trees are fast-growing trees that are the most economically important members of the *Hevea* genus. The milky latex collected from the tree is the principal source of natural rubber, hence it has a significant monetary value. The bark is tapped on a regular basis as a latex-producing crop. The rubber tree's prized latex comprises a variety of compounds, including 36 percent rubber, 5 percent non-rubber components such C-serum and B-serum proteins, carbohydrates, and lipids, and 59 percent water [3].

C-serum protein, a clear serum similar to latex cytosol [4], has been pronounced to have anti-fungal results on *Aspergillus niger* and is a wealthy supply of protein, nucleic acid and multitude of natural compounds [5].

**Table 1: The taxonomic position of *Hevea brasiliensis* is as follows:**

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Euphorbiales
Family	Euphorbiaceae
Sub-family	Crotonoideae
Tribe	Micrandreae
Sub-tribe	Heveinae
Genus	<i>Hevea</i>
Species	<i>brasiliensis</i>

## Physical Characteristics

Table 2: The leaf of *Hevea brasiliensis* is as follows:

Arrangement of leaves	Alternate
Type of leaf	Simple
Margin of Leaf	Entire
Shape of a leaf	Elliptic (oval)
Venation of the leaves	Brachidodrome, pinnate
Persistence of leaf type	Broadleaf evergreen, evergreen
Length of leaf blade	3 ½ to 12 inches
Color of the Leaves	It starts out red, but then turns a dark glossy green
Colors of Fall	There is no change in colour.
Characteristics of Fall	Not showy



Figure 1.a: *H. brasiliensis* panicle with premature flower buds



Figure 1.b: Flowers from *H. brasiliensis*, both female and male

## Fruits

At the age of four, the rubber tree begins to bear fruit. Each fruit contains three or four seeds, which fall to the ground when the fruit ripens and splits. Twice a year, each

tree produces roughly 800 seeds (1.3 kilogrammes). The seed is made up of a thin hard shell and a kernel that contains oil that is used in a variety of industries [8] (Figure 2).



Figure 2: Leave of *H. brasiliensis*



Figure 3: Plant of *H. brasiliensis*



Figure 4: Bark of *H. brasiliensis*



Figure 5: Seed of *H. brasiliensis*

### Seed

Each rubber fruit has a three-seeded ellipsoidal capsule, with one seed in each carpel; seeds are ellipsoidal, 2.5–3 cm long, mottled brown, glossy, and weigh 2–4 g each. From July through September, seeds were collected in India [9] (Figure 5).

### Roots

Although developing 50 to 100 feet tall in its local tropics, with aerial roots that shape trunks assisting the heavy limbs to the ground. The rubber tree is grown due to the fact rubber is crafted from the latex in its bark. Tap-root and creeping roots make up the roots of the rubber tree [10].

### Chemistry

The poisonous seed has 17.6 g protein, 8.5 g H<sub>2</sub>O, 22.9 g total carbohydrate, 48.5 g lipids, 2.5 g ash, 120 mg calcium, and 430 mg potassium per 100 g.  $\alpha$ - and  $\beta$  tocopherol, as well as plastochromanol-S, are found in the leaves. The presence of ubiquinone 9 and 10 heveaflavone, vitexin, and isovitexin is also noticeable. 60 percent

H<sub>2</sub>O, 37 percent caoutchouc, 0.34 percent protein, 1.45 percent quebrachitol, 0.25 percent sugar, 0.53 percent ash, and 0.34 percent unknown components make up the latex. Hevein, L-inosit-2-methylether, indolylaceticacid, trigonelline, ergothioneine, and hercynine are all examples of arachidylalcohol r,  $\alpha$ -,  $\beta$ -,  $\gamma$  and  $\delta$ -tocotrienol. D-apise are found in the bark (C<sub>5</sub>H<sub>10</sub>O<sub>5</sub>). The toxin linamarin is found in the seeds (C<sub>10</sub>H<sub>17</sub>NO<sub>6</sub>). The seed oil (about 40%) contains 7 percent palmitic acid, 9 percent stearic acid, 0.3 percent arachidic acid, 30 percent oleic acid, 30–50 percent linoleic acid, and 2–23 percent linolenic acid [11].

### Cultivation

Seeds, buddings, or a combination of seeds and buddings are used to propagate the plant. When the fruits are ripe, they break open, scattering the seeds up to 33 metres from the tree. Seeds collected and sown sparkling, since they have a short shelf life (maximum 7–10 days), If packed in

charcoal powder or sawdust with 15–20 percent moisture in suitable packaging containers, it can be preserved for up to 4–6 weeks. For budding, seedling wood buds are harvested.

The area in which rubber trees will be planted is cleaned, then covered and marked for roads and drainage. Planting trenches are dug and filled with surface soil and manure, measuring 75 x 75 x 75 cm or 90 x 90 x 90 cm. Seedlings is raised in nurseries or in the discipline at the same time. Seeds germinate approximately 1–3 weeks, depending on the climate and the freshness of the seed. In 6 months, seedlings reach a height of 1–1.3 m. A seedling plot typically has 100,000 plants per hectare, with 60,000 to 70,000 reaching trendy pulling size in 10–15 months. The vegetation is then uprooted, the stem is cut back to 45–60 cm, the taproot is cut back to 45–70 cm, and the lateral roots are cut back to 10 cm. Seedlings make good cuts, whereas rubber-bearing wood takes poorly or not at all. For the period of the monsoon, field transplanting was carried out.

To achieve stands of 250–300 trees per hectare, thinning bud wood densities of 375–450 or seedling densities of 500–600 is encouraged. Intercropping coffee or cocoa, maybe alongside ipecac, is likely to be employed with wider spacing. In place of the generally recommended cover crops, a fodder crop such as *Cajanus* is most often

tried for lac production (*Centrosema*, *Calopogonium*, *Flemingia*, *Pueraria*, and *Psophocarpus*). No N fertiliser is needed after a few years under legumes, however phosphorus, magnesium, and potassium may be limited in some regions. In Vietnam, potassium shortage is common [12].

### Harvesting

Trees are first tapped when they are 5–8 years old, depending on the region, and the number of taps rises year after year until reaching a peak roughly two decades later, after which output is sustained for 40–50 years or more. Tapping is the process of removing a thin slice of bark about 1 mm deep at regular intervals, so triggering the formation of latex vessels within the bark, which can be organised in concentric cylinders and run in counter-clockwise spirals up the trunk [13].

The cuts usually go half-way across the trunk, but they can even encircle the tree. Cuts are made in a variety of styles. Only the bottom 1.3 metres of the trunk are tapped (most latex vessels expand right here). To achieve the desired depth and attitude, special knives are employed. Latex is collected in cups positioned at the end of the cut with a little spout cemented in the bark, large enough to capture one day's flow. Trees are tapped early in the morning when the glide of latex is at its best; as the temperature rises, the flow slows and

eventually stops in approximately 3 hours. In 3 hours, an average tapper can tap 200–300 trees. The tapper then moves lower in the grove and empties the cups into large pails or buckets, occasionally adding a few drops of mild ammonium solution to prevent coagulation. Rubber production can be improved by spraying yield-stimulating combinations comprising plant hormones and selective weed-killers with hormone homes, such as Stimalax, Eureka, 2,4-D, 2,4,5-T in palm oil, on the bark under the faucet. Latex drift is further aided by copper sulphate [14].

#### **Growth Stages of Rubber Plant**

The seeds are large, weighing between 3.5 and 6 g and oval in shape with a little flattened ventral surface. The seed coat, also known as the testa, is firm and lustrous, brown or grey brown in colour with numerous darker mottles or streaks on the floor. With the radicle pointed towards the micropyle, the embryo is located in the centre of the endosperm. The white, veined cotyledons encircle the plumular quit of the embryo's axis and are pressed towards the endosperm. The endosperm accounts for 50-60 percent of the seed's weight. After distribution, the seeds lose viability and quickly deteriorate [15].

Germination occurs hypogeally and usually occurs within a week of seeding. The radicle splits on the hilar depression via the testa, forming a ring of primordia that

quickly develop out as lateral roots. The radicle does not improve any further until the laterals have grown to roughly 2 cm in length, after which it quickly develops to produce the number one tap root. The cotyledons remain inside the seed, but their stalks grow longer, and the plumule emerges from among them. The emerging plumule begins with an inverted U shape, but it quickly straightens itself, withdraws its tip from the seed, and expands rapidly. It takes about 8 days after germination to generate the first pair of leaves [16].

The primary flush of three leaves arises above the internode (**Figure 6**). Parallel to this, lateral roots sprout beneath the first ring of laterals on the major tap root, preserving rapid growth and being well-supplied with root hairs towards the tip.

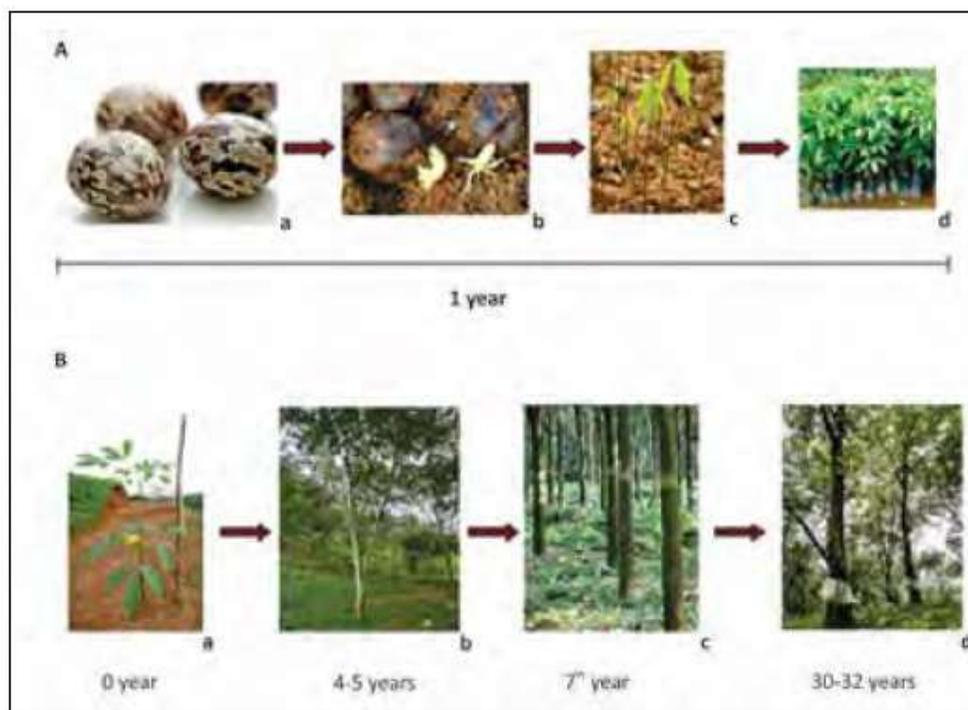
The stem's growth is irregular, with quick elongation of the internode in the direction of the stop, which produces a cluster of leaves, followed by a rest length at a node, during which scale leaves spread around the terminal bud. Leaves are generated in ranges, storeys, or whorls separated by internodes when this sequence is repeated [17, 18].

The leaves are glabrous and have long petioles (approximately 15 cm) with three extra floral nectaries on the tip that push the leaflets upward. Seedlings aged 3 to 12 months are employed as stock plant life for grafting buds from elite clones in order to

elevate elite planting material for commercial cultivation [19]. After a successful bud intake, the shoot above the bud union can be removed, the stumps removed, and the plants either planted immediately in the field or raised in polybags in the nursery. When the plants reach 2 to 3 leaf whorled stages, the nursery raised polybags flowers are subject planted [20].

Under ideal conditions, bud grafted rubber vegetation can grow to a peak of around 2 m per 12 months for the first three years, eventually reaching a peak of approximately

25-30 m in 30 years. Branching is done at a height of around 2.5 metres during cultural operations to adorn the trunk girdling, increase crown length, and prevent wind damage [21]. After the fourth year of subject planting, trees begin to flower. When the tree reaches a girth of fifty cm at a height of 150 cm from the bud union in the seventh year, latex harvesting can begin. The period, however, varies depending on the soil and ambient conditions. The latex crop will be sustainable for another 25 years [22].



**Figure 6: A- Stages of development of rubber. a-seeds; b-early stage of seed germination; c-seedling with fully formed leaf; d-bud grafted plants ready for field planting**

**B- Various stages of development in the field; a- plants with bud grafts that have been field planted; b-plants in the flowering stage; c- a closer picture of the main stem of the field plants ready to begin tapping; d- 30-32 year old plants to be felled for replanting**

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### Edible Uses

The seeds contain 40 - 50% oil. This is suitable for use as food.

### Rubber Plant Health Benefits

A few of the more well-known rubber plant health advantages are listed here.

#### 1. Reduced risk of Developing Allergies

The Rubber Plant's ability to lessen the likelihood of a person having respiratory allergic reactions, including allergies, is one of its key health benefits in terms of air purification. Because this plant also promotes the formation of humidity within a room, pollution and other undesired materials are prevented from becoming dust [23, 24].

#### 2. Anti-Inflammatory Herbs

Skin rashes can be treated with the leaves of this plant. It could be performed by rubbing the infected area on a regular basis with mashed dazzling leaves. Plant roots can also help in rheumatic illness treatment. Boil 30-50 grams of its roots in 2 glasses of water until there is only 1 glass remaining. Allow the water to cool before consuming it [25].

#### 3. Natural pain reliever

Pain reliever compounds have also been discovered in the leaves of the *Hevea brasiliensis* plant, which could aid in the treatment of irritation. Simply mash the clean leaves and rub them on the affected area. Aside from being utilised on the pores and skin, the herb can also be used to treat

enamel irritation. Rather than massaging the mashed leaves, place them in a cup of water and gargle with the solution [26, 27].

### Rubber Plant Benefits and Traditional Uses

- The decoction of aerial rootlets is used as a vulnera.
- Five cases of trichuriasis have been successfully treated using latex.
- Fruit contains a substance called mucilage, which can aid with a number of stomach issues such as nausea, pains, and digestive problems.
- Both dry and uncooked figs can help with constipation.
- Dry fig water is a mouthwash that can be used to treat mouth sores and inflammation.
- Fig water can be used to treat mouth problems and can also be used to prevent coughing.
- Insect bites might be carried out by milky white material in the leaves.
- It has the ability to quickly heal bite rashes and irritation.
- Wounds, cuts, and sores are treated with crushed aerial or adventitious rootlets.
- To stop wounds from bleeding, crushed bark is applied.
- Latex decoction is recommended for parasitic worms.
- In the Philippines, aerial rootlets were decocted and used as a vulnerary for wounds, cuts, and sores [28].

- In Panama, latex is used to treat parasitic worms (*trichuris trichura*).
- In Northern Cameroon, it is used to increase fertility.
- In West Africa, it is used to treat muscle and joint pain.
- Kernels contain oil, which is used in cleaning soaps, paints, and varnishes, as well as being effective against houseflies and lice [29].

### CONCLUSION

Even though the rubber tree is the first-rate source of rubber to be had these days, it's miles going through a few critical threats. Rubber is best created from flora that grown in certain unique regions. In order to increase the resources of herbal rubber and keep away from the dangers of confined manufacturing, we have to look for new rubber-containing flora and improve those already regarded, to try to make them economically competitive. According to the literature *Hevea brasiliensis* traditionally used as a natural anti-inflammatory and analgesic.

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### AUTHORS CONTRIBUTIONS

The initial review and first version were done by authors 1, 2 and 3. The evidence was examined and the final version of the manuscript was completed by authors 1, 4, and 5.

### CONFLICT OF INTERESTS

There are no known conflicts of interest.

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### REFERENCES

- [1] Seeam SM, Islam AS, Raju GS, Istiaq A, Rana S, Babu MH, Rahman MDM, Islam MDJ, Hakim MDL, Das P, Biomedical and Phytochemical Study of Methanol Extract of *Hevea Brasiliensis* Roots in Swiss Albino Mice, *Phytomedicine*, 5(4), 2018, 48-51. [doi.org/10.15562/phytomedicine.2018.70](https://doi.org/10.15562/phytomedicine.2018.70)
- [2] Omokhafa KO, Interaction between flowering pattern and latex yield in *Hevea brasiliensis* Muell, *Arg. Crop Breed, Appl. Biotechnol*, 4: 2004, 280-284.
- [3] An F, Rookes J, Xie G, Cahill DM, Cai X, Zou Z, Kong L, Ethephon Increases Rubber Tree Latex Yield by Regulating Aquaporins and Alleviating the Tapping-Induced Local Increase in Latex Total Solid Content, *J. Plant Growth Regul*, 35, 2016, 701-709. [doi.org/10.1007/s00344-016-9573-6](https://doi.org/10.1007/s00344-016-9573-6).
- [4] M. H. Sanad, F. A. Marzooka, S. K. Mandal, M. Baidya,

- Radiocomplexation and Biological Evaluation of [<sup>99m</sup>Tc] Tricarbonyl Rabeprazole as a Radiotracer for Peptic Ulcer Localization, *Radiochemistry*, 64(2), 2022, 210–21. doi: [10.1134/S1066362222020138](https://doi.org/10.1134/S1066362222020138).
- [5] Singh SK, Kumar SS, Phytochemical and antibacterial efficacy of *Hevea brasiliensis*, *J. Chem. Pharm. Res*, 7(12): 2015, 777-783.
- [6] Baidya M, Anbu J, Akhtar MS, Sarkar S, Mandal SK, Antimicrobial Evaluation of Ethanolic Extract of Selected Seed Shells, *Int J Curr Pharma Res*, 12,2020,74-6. doi: [10.22159/ijcpr.2020v12i6.40286](https://doi.org/10.22159/ijcpr.2020v12i6.40286).
- [7] Dongling Qi, Zhou JN, Xie GS, Wu ZX, Studies on Rubber (*Hevea brasiliensis*) Trees Exist Plant Type after Planting and Available Tapping Tree of Rubber Plantation in China, *Am. J. Plant Sci*, 5: 2014, 3017-3021. doi: [doi.org/10.4236/ajps.2014.520318](https://doi.org/10.4236/ajps.2014.520318).
- [8] Mandal SK, Biswas D, Sony A, De A, Dastider D, Baidya M, Paul S, Dawn S, Mandal S, Plants and phytochemicals in the treatment of colorectal Cancer: recent updates, *Int. j. biol. pharm. allied sci*, 10(10),2021, 3502-3521. doi: [10.31032/IJBPAS/2021/10.10.5657](https://doi.org/10.31032/IJBPAS/2021/10.10.5657).
- [9] Dafoe JT, Huang F, Yang TC, Quantitative Analysis of Anti-*Hevea brasiliensis* Antibody Cross-Reactivity Against *Taraxacum kok-saghyz* Latex Proteins Demonstrates Significantly Reduced Antibody Recognition, *J. biotechnol. Biomater*, 7, 2017, 270. doi: 10.4172/2155-952X.1000270.
- [10] Baidya M, Jayaraman A, Maji HS, Ramya Krishna PS, Das D, Evaluation of acute and sub-acute toxicity of sivanar amirtham in albino mice and wistar albino rats, *J. Med. P'ceutical Allied Sci*, 11 - I 1, 2022,2022, 4196 - 4204. doi: [10.22270/jmpas.V11I1.2217](https://doi.org/10.22270/jmpas.V11I1.2217).
- [11] Abolagba EO, Aigbekaen EO, Omokhafa KO, Farm gate marketing of natural rubber in south east rubber growing zone of Nigeria, *J. Agric. Rural Dev. Trop. Subtrop*, 6, 2003,40-48.
- [12] Aigbekain EO, Imarhiagbe EO, Omokhafa KO, Adoption of some recommended agronomic practices of natural rubber in Nigeria, *Int. j. agric. for. Fish*, 1(2), 2000, 51-56.
- [13] Mandal SK, dawn S, Mondal S, Sarkar S, Mandal R, Baidya M, Paul S, Pramanick A, Dastider D,

- Sen DJ, Das A, Kolay A, The therapeutic versatility of quinolines, *Int. j. biol. pharm. allied sci*, 10(7), 2021, 2161-2181.[doi.org/10.31032/IJBPAS/2021/10.7.5528](https://doi.org/10.31032/IJBPAS/2021/10.7.5528).
- [14] Daruliza KMA, Lam KI, Yang KI, Priscilla JT, Sunderasan E, Ong MT, Anti-fungal effect of *Hevea brasiliensis* latex C-serum on *Aspergillus niger*, *Eur Rev Med Pharmacol Sci*, 15, 2011, 1027-1033.
- [15] Ramya Krishna PS, Jayaraman A, Baidya M, Nayak DA, 2022, Toxicological evaluation of fucoidan, a polysaccharide isolated from *Turbinaria conoides* (J.agardh) Kutzing procured from mandapam coastal area, tamilnadu, *J. Med. P'ceutical Allied Sci*, 11 - I 2, 2022, 4629 – 4635. [doi: 10.55522/jmpas.V11I2.2511](https://doi.org/10.55522/jmpas.V11I2.2511).
- [16] Arokiaraj P, Ruker F, Obermayr E, Bahri S, Hafsah J, Carter DC, Yeang HY. Expression of human serum albumin in transgenic *Hevea brasiliensis*, *J. Rubber Res*, 5 (3), 2002, 157–166.
- [17] Jayashree R, Rekha K, Venkatachalam P, Sushamakumari S, Sobha S, Supriya, R, Neethu PK, Thulaseedharan A, Nazeem PA. *Agrobacterium* mediated transformation with the laticifer specific HMGR1 gene in *Hevea brasiliensis*. International Conference on “Biotechnology: A Global Scenario”. 2-4 Nov. Kakatiya University, Warangal, India. 2011,144.
- [18] Tangphatsornruang S, Uthapaisanwong P, Sangrakru D, Chanprasert J, Yoocha T, Jomchai N, Tragoonrung S, Characterization of the complete chloroplast genome of *Hevea brasiliensis* reveals genome rearrangement, RNA editing sites and phylogenetic relationships. *Gene*, 475, 2011, 104 -12.
- [19] Ismun A, Ariffin MM, Razak SBA, Wei OC, Ahmad FT, Mubarak A, Determination of polyphenol contents in *hevea brasiliensis* and rubber-processing effluent, *Malaysian J. Anal. Sci*, 22(2), 2018, 185–196. DOI: <https://doi.org/10.17576/mjas-2018-2202-03>
- [20] Agbai CM, Olawuni IA, Ofoedu CE, Ibeabuchi CJ, Okpala COR, Shorstkii I, Korzeniowska M, Changes in anti-nutrient, phytochemical, and micronutrient contents of different processed

- rubber (*Hevea brasiliensis*) seed meals, Peer J, 9, 2011, 11327.
- [21] Baidya M, Maji HS, Bhatt S, Das D, In-vitro Evaluation of the Thrombolytic and Anti-inflammatory Activity of *Capparis sepiaria* Root Extracts, J. Med. P'ceutical Allied Sci, 2022, 11(1), 4166-4171. doi: 10.22270/jmpas.V11I1.1879.
- [22] Yang, GM, Effective Factors Analysis on Reducing the Number of Rubber Trees for Guangxi State Rong Guang Farms of Rubber Plantations, World Tropical Agriculture Information, 46, 2008, 25.
- [23] Li ZQ, Impact Analysis and Countermeasures of "David" Typhoon on Rubber Production in Hainan State Farm, Chinese Society of Tropical Crop Natural Rubber Professional Committee Symposium, Nanjing, 2006, 97-106.
- [24] Mo YY, Huang HS, Changes in Trade Policy and Development Ideas of Natural Rubber Industry, Chin. J. Anal. Chem. in China, 6, 2009, 8-11.
- [25] Rao PS, Saraswathyamma CK, Sethuraj MR, Studies on the relationship between yield and meteorological parameters of para rubber tree *Hevea brasiliensis*, Agric For Meteorol, 90, 1988, 235-245.
- [26] Premakumari D, Saraswathyamma CK, The Para Rubber Tree. In: Natural Rubber- Agromanagement and Crop Processing (Ed. P.J.George & C. Kuruvilla Jacob). Rubber Research Institute of India. Kottayam, 2000, 29-35.
- [27] Lam KL, Yang KL, Sunderasan E, Ong MT, Latex C-serum from *Hevea brasiliensis* induces non-apoptotic cell death in hepatocellular carcinoma cell line HepG2, Cell Prolif, 45(6), 2012, 577- 585.
- [28] Lalabe BC, Olusiyi JA, Afolabi KD, Effects of soaking on the nutritive value of raw full fat rubber (*Hevea Brasiliensis*) seed, J. Agric. Food Environ, 13(2), 2017, 78-82.
- [29] Wititsuwannakul D, Chareonthiphakornb N, Pacc M, Wititsuwannakul R, Polyphenol oxidases from latex of *Hevea brasiliensis*: Purification and characterization, Photochemistry, 61(61), 2002, 115-121.