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HEPATOPROTECTIVE ACTIVITY OF ACHYRANTHES AGAINST JAUNDICE - A REVIEW

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ABSTRACT

Yellowing of the skin, eyes, or mouth might mean bilirubin levels are high in the blood. This shows up when the body handles bilirubin poorly - sometimes due to red blood cell breakdown, sometimes liver trouble, other times a bile pathway blockage. Depending on where things go wrong, it gets labeled before the liver, inside the liver, or after. Conventional methods used for these cases can bring unwanted reactions or fall short in results, so some turn toward plant-based alternatives instead. This research focuses on creating and evaluating a plant-based syrup meant to support liver function and address jaundice. Selection of species such as Achyranthes aspera, Phyllanthus niruri (Bhui amla), Ocimum sanctum (Tulsi), alongside Carica papaya leaves followed historical usage patterns combined with documented biological activities including oxidation control, inflammation reduction, virus suppression, and liver cell protection. From the plants came bits picked by hand, washed clean under running water. Dried slowly in shaded air, then crushed down until fine like dust. A machine called Soxhlet pulled out active parts using alcohol mixed with water - kept going for hours. After that, what was drawn out got concentrated, richer than before. Into a thick sweet base it went, where honey joined sucrose without fuss. Preserved with sodium benzoate so nothing spoiled too soon. Ascorbic acid slipped in to keep color bright. Polyethylene glycol helped everything stay smooth. Carboxymethyl cellulose gave body, just enough thickness. Citric acid brought a sharp note underneath. Peppermint oil finished it off with cool scent. A look at the mix showed things like acidity, thickness, how many microbes were present, also what it smelled and tasted like. This blend of herbs could work well as medicine that is gentle on the body, does not cost

much, fits people easily - particularly kids and older adults. Working together, plant parts might help the liver do its job better while lowering bilirubin amounts. To back up these effects with proof, more lab tests plus real-world trials should happen next.

KEYWORD: Jaundice, Bilirubin, Hepatoprotective, Herbal syrup.

1. INTRODUCTION

1.1 Jaundice

Jaundice is defined as a yellowing of skin, mucous membranes and sclera due to the deposition of yellow- orange bile pigment i.e. bilirubin. The bilirubin is an endogenously synthesized pigment that can be toxic specially in newborn children. The bilirubin in unconjugated form has a typical spectrographically peak at 450 nm. The word Jaundice is actually a derivative of French word ‘Jaune’ which means ‘yellow’. Jaundice indicates the hyper bilirubinaemia and that excessive level of bilirubin may be in conjugated or unconjugated form. The clinical presentations of jaundice appear when bilirubin level exceeds 34.2 µmol/L or 2 mg/dL.

Bilirubin forms when the body processes a component known as the heme group. When heme oxygenase acts, it splits heme at the alpha carbon bridge - this step frees iron, carbon monoxide, and biliverdin. Following that transformation, biliverdin becomes bilirubin through the work of another enzyme, biliverdin reductase. Most bilirubin comes from hemoglobin's heme portion, which accounts for roughly 80 percent of the total. Red blood cell breakdown happens mainly in the liver, spleen, and bone marrow through the reticuloendothelial system, forming haemoglobin. While most bilirubin arises there, a fifth stems from sources like myoglobin or cytochromes elsewhere in the body. 6,7 Daily production in normal adult individuals measures roughly 3.8 mg per kg of weight - adding up to around 250–300 mg formed each day.

Most newborns create far greater amounts of bilirubin compared to grown-ups. Once formed, this substance travels toward the liver while attached to plasma albumin. For the initial binding spot on albumin, the dissociation constant measures Kd=7 X 107M-1. Instead of staying inactive, bilirubin undergoes changes in the liver through an enzyme called UDP-glucronyltransferase - this step allows it to mix with water so elimination becomes possible. Older people might process certain chemicals differently. How this happens depends partly on body chemistry plus life stage. Picture a quiet shift when liver helpers respond to signals

from inside the body. Hormones whisper changes; outside drugs shout louder effects. A key player named UDP-glucuronosyltransferase adjusts its pace under these pressures. Once bilirubin links up through that pathway, it dissolves easily. Then bile takes hold without delay. Down narrow tubes, this fluid drifts toward the gut's early chamber. Inside the bowel, tiny guests - microbes - split some molecules apart. What remains turns into something new: urobilinogen among shadows of breakdown. Much floats back into bloodstreams quietly. From there, another filter steps in much later. Kidneys catch those returns efficiently. Out they go, flushed slowly via urine networks. Each phase connects across organs like hidden threads. See them mapped out carefully in Figure 1.

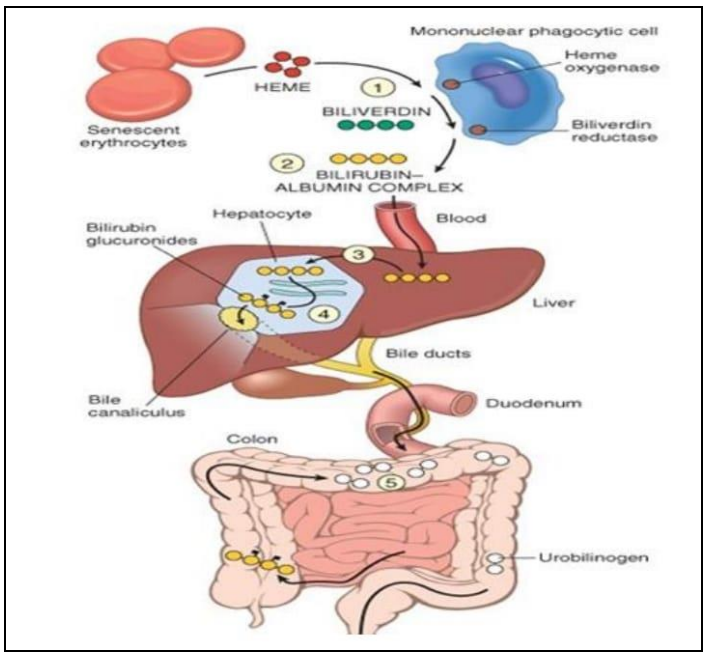

Fig. 1.1: Production and metabolism of bilirubin.

1.2 Types of Jaundice

Based on causes Jaundice can be classified into three types.

1) Pre-hepatic Jaundice
2) Hepatic Jaundice
3) Post hepatic Jaundice

Pre-hepatic Jaundice

Pre hepatic jaundice is such type of jaundice which is caused due to hemolysis therefore it is also known as haemolytic jaundice. The major cause of enhanced haemolysis is defective plasma membrane of red blood cells. This vulnerable cell membrane cannot bear the shear stress and hence ruptures resulting in hemolysis thus causing the increased serum bilirubin

level.

Hepatic jaundice

Hepatic jaundice is a type of jaundice in which the basic defect lies within the liver mainly in the hepatocytes. The liver captures bilirubin from plasma proteins mainly albumin, then after conjugation excretes in the bile via biliary system. Any pathology of the liver leading to defect in capture, conjugation and excretion can cause hepatic jaundice. Main enzyme of conjugation is UDP-Glucosyltransferase. This is commonly immature at birth, and its under-activity can cause so called Neonatal Physiological Jaundice. Further this enzyme can be defective due to the genetic mutation of the UTG1A gene on chromosome 2. This gene encodes for UDP- Glucosyltransferase and thus the defective conjugating enzyme leads to the hepatic jaundice. Any defect in the hepatic excretory mechanism of bilirubin can also cause hepatic jaundice. The excretory mechanisms involve hepatocytic bile acid-independent secretion, hepatocytic bile acid-dependent secretion and bile ductular secretion. Any defect in the above-mentioned excretory mechanisms can lead to the accumulation of bilirubin in blood causing hepatic jaundice.25-34 Overview of hepatic jaundice is given in Figure 1.

Post hepatic jaundice

Bile flow gets blocked after leaving the liver, that's what leads to post hepatic jaundice. This kind often comes from a blockage outside the liver in the bile ducts. Because of this backup, the condition picks up the name obstructive jaundice. Such issues stop bilirubin from moving forward normally.

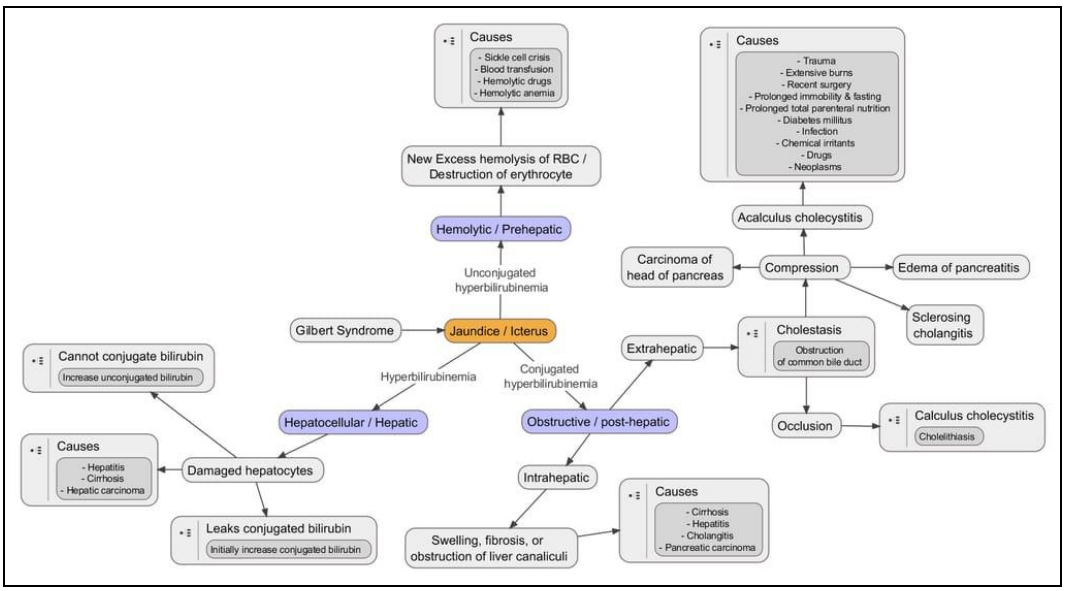

Fig. 1.2. Overview of types and causes of jaundice.

Liver diseases which are still a global health problem may be classified as acute or chronic hepatitis (inflammatory liver diseases), hepatitis (non-inflammatory diseases) and cirrhosis (degenerative disorder resulting in liver fibrosis). Unfortunately, treatments of choice for liver diseases are controversial because conventional or synthetic drugs for the treatment of these diseases are insufficient and sometimes cause serious side effects. Since ancient times, mankind has made use of plants in the treatment of various ailments because their toxicity factors appear to have lower side effects. Many of the currently available drugs were derived either directly or indirectly from medicinal plants. Recent interest in natural therapies and alternative medicines has made researchers pay attention to traditional herbal medicine. In the past decade, attention has been centred on scientific evaluation of traditional drugs with plant origin for the treatment of various diseases. Due to their effectiveness, with presumably minimal side effects in terms of treatment as well as relatively low costs, herbal drugs are widely prescribed, even when their biologically active constituents are not fully identified.

Most natural treatments for liver issues go way back. Yet proof behind many claims remains thin, even if certain blends contain ingredients shown to fight oxidation, inflammation, cancer, fibrosis, or viruses. Research exists on quite a few herbs and mixtures, though results often fall short. One problem is how effects get tested - usually in lab animals with minor chemical-triggered liver harm. Why doubt lingers becomes clear once you consider inconsistent herb quality, too few solid human trials using proper controls, missing safety data from long-term animal tests.

Yellowing of the skin, eyes, and inner linings shows up when too much bilirubin builds in the bloodstream. This often happens if the liver isn’t working well, red blood cells break down too fast, tubes carrying bile get blocked, or liver tissue gets hurt. Since the organ handles processing bilirubin, cleaning toxins, and balancing body chemistry, any harm to it tends to deepen both onset and intensity of the yellow tint.

Something protects liver cells by stopping harm before it happens. Lately, plants used in medicine caught interest because they carry natural chemicals. Flavonoids sit alongside saponins, while alkaloids mix with phenolics inside these green sources. What makes them stand out is how they fight swelling, block harmful reactions, and steady cell walls. Oxidative strain drops when these plant parts step in. They also stop fats from breaking down badly in tissues. Liver units keep their shape better thanks to such support.

Some healing plants like Achyranthes aspera, Phyllanthus niruri, Andrographis paniculata, and Curcuma longa were tested by researchers to see how they affect liver health and jaundice. Instead of just listing benefits, studies looked at real changes - how these herbs boost the body's own defenses against damage. One way they work is by turning up the activity of natural antioxidant enzymes. At the same time, bile flow gets a subtle push in the right direction. Inflammation signals shift too, quietly guided by plant compounds. Lab tests show balance returning to key numbers: ALT drops, AST follows, ALP adjusts, and bilirubin eases down.

Lately, tests on animals and cells show certain natural plant parts can protect the liver better than lab-made medicines - they tend to cause less harm. What makes them effective is how their different active ingredients boost one another, helping the liver heal faster. Though science still explores details, these plant solutions stand out where liver problems are common, especially areas hit hard by viruses or heavy drinking. With more research, such herbs might lead to stronger treatments down the road.

1.3 Therapeutic approaches and managements

Pre-hepatic jaundice

Infusion of immunoglobulins is used as primary treatment for pre-hepatic jaundice. Phototherapy is considered as an effective treatment of high levels of bilirubin in pre-hepatic jaundice. Bilirubin rapidly decreases within two hours of onset of phototherapy. However, the duration of therapy and the strength of light treatment depend upon the severity of hyperbilirubinemia. Metaloporphyrins are also considered as a treatment possibility of pre-hepatic jaundice, because these metaloporphyrins target the hemeoxygenase enzyme to limit the production of bilirubin.

Hepatic jaundice

Treatment and Management of hepatic jaundice involve

• Phototherapy - for neonatal jaundice.

Though phenobarbital helps with newborn jaundice, drowsiness and fever-related seizures make doctors hesitant. Its role fades when side effects show up early. Rarely picked now because risks weigh more than benefits. Sleepiness often follows the dose, which worries caregivers. Fever-triggered convulsions scare even seasoned staff. So alternatives take priority in most nurseries.

Most care focuses on hydration, along with enough rest and managing discomfort when dealing with Hepatitis A. Recovery often moves forward without special drugs, just steady support while the body heals itself. Symptoms tend to fade over time if basic needs are met consistently throughout the illness.

Stopping alcohol helps the liver recover. Some medicines can harm the liver - taking them must stop too.

- Steroids - for autoimmune hepatitis.
- Immunosuppressant - for autoimmune hepatitis.

Interferon treats long-term hepatitis B along with hepatitis C. This medication targets viral activity over extended periods. It works by adjusting immune responses where needed most. Treatment duration varies depending on patient factors. Response rates differ across individuals using interferon therapy.

Liver transplant helps people with sudden severe hepatitis. Sudden organ shutdown makes surgery necessary. When the liver stops working completely, replacement becomes a path forward. Severe damage beyond recovery leads doctors toward donated organs. Whole organ swap happens when no healing is possible.

Post hepatic jaundice

Low fat diet should be given to patient suffering from post-hepatic jaundice to minimize the discomfort due to fat ingestion and diarrhoea's treatment of the post hepatic obstructive jaundice is mechanical decompression however, the complications and other symptoms are also necessarily treated. Decompression can be done bysurgical bypass, percutaneous insertion of stents, removal of lesions and endoscopic insertion of stents. Dexchlorophenramine, Hydroxyzine, Cholestyramine, Ursodeoxycholic acid and Naltrexone are used as a therapeutic approach in treatment and management of post hepatic jaundice.

2. HERBAL SYRUP

Herbal syrup it is a defined as a prepared and combination and concentration decoction with Honey sugar or either some time use alcohol. The base of such syrup is a strong herbal decoction and mixing a decoction with sugar honey help to thicken preserves the decoction. Herbal plant and formulation are used for many types of disease like cough syrup and other disease. The cough syrup many types of herbal plant are used for pudina, Tulsi, Cinnamon,

honey in that whole plant are used for making herbal medicine the many years. Herbal formulation a most used a development as well as developing countries as health care. The cough syrup medication is a liquid dosage form use of oral liquid pharmaceutical has been confirmed on basic ease of administration to those people who have the problem in the swallowing of solid dosage from medication. Syrup is a concentrated solution contains sugar and purified water. In syrup from the other type of syrup solutions. The syrup maybe or may not be containing medication or mixed flavoring agent. When the syrup without a medication but the flavoring agent present are known as flavored or non-medicated syrup. Flavored syrups are frequently used as vehicle for the unpleasant test of medications results (found as) is medicated syrups. Syrup are present in syrup in high amount predisposes then to the bacteria infection so they are often. Use as preservative.

Types of herbal syrup

1) Flavoured syrup
2) Medicated syrup
3) Artificial syrup

Advantages of herbal syrup

- No side effects
- No Harmless
- Easily available
- Easy to adjust the dose for child's weight
- No nursing is required, which main and the patient can take it with no help.
- The liquid dosage form is executed for products like cough medicines.
- Herbs Grow in common place.
- Antioxidant by retarding the oxidation as sugar is Hydrolyzed into cellulose and dextrose
- Good patient compliance especially pediatric patients as syrup are sweet in test
- It is a preservative by retarding the growth of bacteria, fungi and mould as osmotic pressure.

Disadvantage of herbal syrup

- Sedimentation of solid occasionally gives foot from of product.
- Dose precision cannot be achieved unless suspension suspensions are packed in unit dosage forms.

- Same microbial contamination take place its preservation not added in accurate proportion.
- Also, herbal medicine having another disadvantage is the risk of self-dosing of herbs which is very rare.
- Fluctuation in storage temperature may cause crystallization of sucrose from saturated syrup.

2. PLANT PROFILE

Fig.1.1 Achyranthes aspera.

Fig.1.2 Bhui amla.

Fig.1.3 Tulsi.

Fig. 1.4: Papaya.

1. Achyranthes aspera

Synonyms Chaff Flower Prickly Chaff Flower Apamarga Hindi Sanskrit

From the ground up, Achyranthes aspera comes from either the full plant or just its roots. This species grows year after year, part of a long-living green type called a perennial herb. Known by its Latin name Achyranthes aspera Linn., it stands distinct among similar forms. While some take only certain pieces, others harvest everything together. Root alone may serve sometimes, yet entire structure works too.

Found across India and in tropical and subtropical areas of Asia Africa and Australia
Family: Amaranthaceae
Plant compounds include alkaloids saponins flavonoids glycosides triterpenoids ecdysterone potassium salts.

Swelling goes down when this is used. Infections find it hard to survive because of its germ-fighting trait. Worms get pushed out of the gut. It makes the body shed extra water through urine. Coughing becomes less frequent, breathing eases during tight chest episodes. Skin rashes or sores respond well over time. Wounds close faster when applied as part of old healing ways. Upset stomach, bloating, indigestion - these issues often soften in intensity.

2 Bhui amla

Bhui Amla Bhumyamalaki Stonebreaker Chanca Piedra
From nature, it comes entirely from a small herb called Phyllanthus niruri. This plant is used in full - no part left behind. Its roots, leaves, stems - all make up what's known as Bhui Amla. Found commonly in tropical regions, the entire structure counts. Not just one section matters; every piece plays a role. The complete organism defines its origin.
Family: Phyllanthaceae
Bhui Amla pops up across tropical parts of India. Not just there - it also thrives deep in South American soil, think Brazil or even stretches of Peru. You'll spot it too through pockets of Southeast Asia. Often found where dampness lingers under light tree cover, growing wild without asking permission.
Lignans Phyllanthin Hypophyllanthin Flavonoids Quercetin Rutin Alkaloids Tannins Terpenoids
Starting off, it shields the liver - common when dealing with yellowing skin. Moving on, fights viruses, particularly one that hits the liver hard. Instead of just sitting idle, it pushes fluids through the kidneys. When minerals clump up inside, this helps break them apart slowly. Not only does it calm irritation, it also tackles damage from unstable molecules. Rooted in ancient practice, healers apply it for gut and bladder troubles alike.

3. Tulsi

Tulsi goes by another name - sacred basil. Sometimes it's called holy basil too.

From the plant called Ocimum sanctum Linn. comes Tulsi - its leaves, either fresh or dried. This species grows in the Labiatae family group. Parts used are harvested when mature. You

find them on plants grown wild or cultivated. Leaf material forms the main supply source. The botanical name stays key for correct ID. Family ties link it to similar aromatic herbs.

From dusty roadsides to temple courtyards - this leafy annual springs up across India, branching wildly at every turn. Though treated with reverence among Hindu communities, its presence feels ordinary, almost quiet. Gardens host it, yes - but so do forgotten corners beside stone steps and prayer halls. New plants rise from tiny seeds dropped into soil without ceremony. These days, fields stretch farther than before, all for capturing the scent trapped in its leaves. Oil becomes product; tradition meets trade.

Inside the plant, a light-smelling oil shows up - about 0.1 to 0.9 percent. Not far behind, eugenol fills nearly seven-tenths of that mix. Carvacrol tags along at three percent. Meanwhile, twenty percent takes form as eugenol methyl ether.

4. Papaya Laves

Papaya Tree Varieties Papaya Fruit Types

Papain Cystatin Chymopapain Tocopherol

Tropical And Subtropical Regions Of Brazil Australia Malaysia China India Thailand Myanmar Philippines

Family: Caricaceae

Carpaina and Nictoflorin

Papaya leaves come into play when dealing with swelling inside the body. When blood sugar needs balancing, these leaves show up as a choice. Jaundice treatment sometimes includes them too.

3. MATERIAL AND METHOD

Collection and Processing of Plant Material

From the Nursery came both roots and leaves of Achyranthes aspera Linn. These plant pieces got rinsed well under distilled water, washing off dirt and particles stuck on them. Once clean, they spent time drying inside a heated chamber set at steady warmth - until their mass stopped changing. After full drying, a machine turned them into fine powder, later kept sealed tight in closed vessels, waiting ahead for what follows.

Extraction of Herbal Materials

From the dry parts - roots and leaves - of Achyranthes aspera, Phyllanthus amarus (Bhui

Amla), Ocimum sanctum (Tulsi), alongside Carica papaya leaves, powder formed after grinding. Through a No. 40 sieve it went, ensuring even grain. Using a mix of water and alcohol, the fine dust underwent extraction via Soxhlet apparatus. Out came the liquid, strained clean by filtration. Then, under low pressure, rotation spun off the fluid, leaving behind something thick, almost solid. Afterward, with vacuum drying applied, what remained transformed into a dense, syrup-like concentrate.

Formulation of Herbal Syrup

From clean plant parts - Achyranthes aspera, Bhui amla, Tulsi, papaya leaves - the process began. Washing came first, then drying under shade, finally grinding into fine powder. Instead of quick methods, extraction used a Soxhlet device for deeper pull. Liquid form emerged after prolonged heating and condensation cycles. Standard lab steps shaped how the syrup took form.

Cooling an aqueous base took place before anything else. Into that mixture went the herbal extracts once ready. Honey or sucrose slipped in along with sodium benzoate to keep things stable. Ascorbic acid followed, doing its job against oxidation. Polyethylene glycol made sure everything stayed mixed. Peppermint oil brought a touch of scent near the middle stage. Carboxymethyl cellulose helped particles stay suspended without settling fast. Citric acid adjusted the balance at the close.

A bit of purified water brought the mix up to its final volume, then it passed through a tight mesh filter. After that came testing - pH levels, thickness, microbes present, plus how it looked and tasted. Into proper bottles it went at last, sealed and packed without fuss.

4. FORMULATION STUDY

Materials: Achyranthes aspera extract, Phyllanthus niruri (Bhui amla), Ocimum sanctum (Tulsi), Carica papaya leaves, ascorbic acid, sodium benzoate, honey/sucrose, polyethylene glycol, peppermint oil, carboxymethyl cellulose, and citric acid.

Method of Preparation

From freshly gathered specimens, thorough washing followed by drying under shaded conditions took place prior to grinding into fine powder.

From a powdered sample, extraction took place through a Soxhlet system employing a mix of water and alcohol as solvent. Following this, concentration occurred under reduced pressure

via a rotating evaporation device.

Starting with sugar dissolved in clean water forms the syrup base. Then, certain additives help preserve it. Stability comes through inclusion of specific agents. Water used must meet purity standards. Preservation happens alongside stabilization during preparation.

Blending begins by combining extracts with the foundational substance. Following this step, inactive ingredients enter the mixture gradually. The total amount then gets fine-tuned to meet target levels.

Cooling happens first, then filtration follows - temperature drops under forty degrees Celsius. Process ends clean, chilled.
Evaluation: pH, viscosity, microbial load, organoleptic properties tested.
Bottles colored brown hold the contents when sealed correctly. Proper storage follows right after filling.

5. CONCLUSION

Liver trouble often shows up as jaundice, marked by yellow skin and high bilirubun levels. From nature's shelf comes a fresh take - a syrup built on Achyranthes aspera, Phyllanthus niruri, Ocimum sanctum, alongside Carica papaya. Packed inside are active plant compounds like flavonoids, alkaloids, along with saponins. These pieces fight stress in cells, ease swelling, while guarding liver tissue at the same time. Their strength lies not in one single part but how they work together behind the scenes. Though made using standard methods to ensure it stays stable and safe for people, the syrup shows promise. Liver support and relief from jaundice could be possible without high costs, yet proof of real medical benefit still waits on further testing.

6. REFERANCES

1. Abbas, M. W., Shamshad, T., Ashraf, M. A., & Javaid, R. Jaundice: a basic review. Int J Res Med Sci., 2016; 4(5): 1313-9.
2. Jadhao, A. G., Sanap, M. J., & Patil, P. A. Formulation and evaluation of herbal syrup. Asian Journal of Pharmaceutical Research and Development, 2021; 9(3): 16-22.
3. Singh, S., & Singh, D. R. Phytochemical and pharmacological profile of Achyranthes aspera Linn. International Journal of Pharmaceutical Sciences Review and Research, 2010; 3(2): 45–49.

4. Patel, J. R., Tripathi, P., Sharma, V., Chauhan, N. S., & Dixit, V. K. Phyllanthus amarus: Ethnomedicinal uses, phytochemistry and pharmacology: A review. Journal of Ethnopharmacology, 2011; 138(2): 286–313.
5. Saini, M., & Mamgain, S. (Year). Herbal syrup for the treatment of jaundice: A review. Dev Bhoomi Institute of Pharmacy and Research, Dehradun.
6. Khandelwal, K. R. (2008). Practical pharmacognosy: Techniques and experiments (19th ed.). Nirali Prakashan.
7. Kokate, C. K., Purohit, A. P., & Gokhale, S. B. (2010). Pharmacognosy (46th ed.). Nirali Prakashan.
8. Allen, L. V., Popovich, N. G., & Ansel, H. C. (2013). Ansel's pharmaceutical dosage forms and drug delivery systems (10th ed.). Lippincott Williams & Wilkins.
9. Patel, D. K., Kumar, R., Laloo, D., & Hemalatha, S. Phyllanthus amarus: Ethnomedicinal uses, phytochemistry, and pharmacology. Journal of Ethnopharmacology, 2011; 138(2): 286–313.
10. Prakash, P., & Gupta, N. Therapeutic uses of Ocimum sanctum (Tulsi) with a note on eugenol and its pharmacological actions: A short review. Indian Journal of Physiology and Pharmacology, 2005; 49(2): 125–131.
11. Aulton, M. E., & Taylor, K. (2018). Aulton's pharmaceutics: The design and manufacture of medicines (5th ed.). Elsevier.
12. Indian Pharmacopoeia Commission. (2018). Indian Pharmacopoeia (8th ed.). Government of India, Ministry of Health and Family Welfare.