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Extraction Encapsulation and Development of Functional Food of Some Selected Indian Antiviral Herbs

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Abstract:- In this review, we have taken few Indian herbs and studied their antiviral activity. The method of encapsulation and extraction of these selected herbs having high efficiency and effectiveness. The herbs selected in these studies are Ghritkumari, Amla, Guduchi, Ashwagandha, Arjuna, Brahmi, Punarnava, Sarpagandha, and Shatavari. Different extraction procedures were implemented to preserve its effectiveness. Encapsulation of these is performed to retain its properties and store the herbs for some time. These herbs are effective against viruses like Hepatitis C, herpes simplex virus, influenza virus, HSV-2, etc. Different functional food has been prepared to have a high amount of bioactive components.
Keywords: *Antiviral activity, Encapsulation, Functional food, Bioactive Component*

I. INTRODUCTION

India has a wide variety of herbs that grow throughout its region. The herbs selected in these studies are Ghritkumari, Amla, Guduchi, Ashwagandha, Arjuna, Brahmi, Punarnava, Sarpagandha, and Shatavari. The herbs having different properties so can be used to prepare different medicines, foods, oils, and condiments. The primary objective of the study is to know about antiviral activity. These herbs are effective against viruses like Hepatitis C, herpes simplex virus, influenza virus, HSV-2, etc. The efficacy of these herbs being disease resistant was high. Here we have taken some herbs and studied their extraction procedure where the herbs having their bio-active components intact and functional. Then we studied about the encapsulation procedure there are various encapsulation procedure was taken to preserve their efficacy intact. Encapsulation of these is performed to retain its properties and store the herbs for some time. From concept to effective market implementation, functional food creation comprises numerous separate stages. The goal of this study is to define the processes involved in each of these stages, starting with the translation of an important notion into a commercial prototype. These prototypes must next be tested for efficacy and safety in animals and humans.Publication of efficacy and safety data improves the credibility of functional food products, which leads to increased consumer awareness and, in turn, regulatory approval and the formulation of health claims.

II. EXTRACTION

Ghritkumari - Aloe Vera leaves were air-dried and smashed into small pieces using a Mortar and Pestle before being powdered in an electric grinder. The powdered plant material was treated to a series of soxhlet extractions, beginning with non-polar solvents and progressing to polar solvents such petroleum ether [PE]. Soxhlet extracts were used to extract chloroform [$CHCl_3$] and methanol [MeOH]. The extracts were concentrated until they were completely dry. [1]

Amla – Fresh leaves of Emblica officinalis were collected. The freshly collected leaves were thoroughly washed thrice in distilled water, shade dried, powdered using a mechanical blender, and subjected to extraction using solvents such as methanol, ethanol, ethyl acetate, and chloroform separately using Soxhlet apparatus. [2]

Guduchi - T.cordifolia leaves and stems were shade dried for 5 days before being processed into powder. To prevent the loss of active components, sunlight was avoided. Separately, 100 gms of leaf and stem powders were soaked in 1000ml of double distilled water and maintained at room temperature for 3 days with periodic shaking. A cotton cloth was used to filter the extracts. To remove the water, the extracted liquids were evaporated in a water bath. Liquid extracts were placed in a beaker and exposed to water bath evaporation at 60°C temperature for 7-10 hours everyday for 3-4 days until the extracted liquid reached a semisolid form. The semisolid extracts were maintained in the deep freezer overnight at -20°C before being freeze dried. Extracts obtained by this method were then weighed and percentage yield was found to

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be stem 16.73 %, leaf 10.73%. The above aqueous extracts were stored at 4 °C until further use. [3]

Ashwagandha - Fresh leaves were thoroughly washed 2–3 times with running water before being rinsed with sterile distilled water. Washed leaves were air-dried in the shade at room temperature before being pulverised with a mortar and pestle. Shade dried leaf powder was shaken overnight in methanol and then extracted successively in the Soxhlet apparatus. The extract was filtered using Whatman's number one filter paper, and the filtered solution was evaporated using a rotary evaporator under reduced pressure. [4]

Arjun - The samples were carefully washed under running tap water, followed by sterile distilled water, and air-dried at room temperature (40°C) for 4-5 days before being homogenised to a fine powder and stored in airtight bottles. For extraction, four different solvents were used: ethanol, methanol, acetone, and aqueous (hot and cold).A total of 10 g of homogenised bark and leaves were soaked in conical flasks containing 100 ml of acetone, ethanol, methanol (95%), and sterile distilled water. In addition, 10 g of homogenised bark and leaves were immersed separately in 100 ml of hot sterile distilled water in conical flasks and allowed to stand for 30 minutes on a water bath with occasional shaking.After that, place all of the flasks on a rotary shaker set to 200 rpm for 24 hours 29-31. Each preparation was filtered through sterilised Whatman No.1 filter paper before being concentrated to dryness using a Rota evaporator under vacuum at 40°C. The dried extract was sterilised by overnight UV-irradiation, tested for sterility on nutrient agar plates, and stored at 4°C in labelled sterile containers. [5]

Bramhi – The dried plant material was macerated in 180 ml of 95 percent ethanol at room temperature for three days before being filtered through filter paper. The filtration residue was extracted twice more using the same method. The filtrates were combined and then evaporated under reduced pressure to dryness.[6]

Punarnava - The plant leaves were thoroughly washed, desiccated in the shade, and powered. Using the Soxhlet apparatus and 95 percent ethanol as the solvent, 200gm of powdered material was successfully extracted. The solvent was evaporated after two days of extraction, and the residue obtained was used for the studies. The extract was dissolved in Dimethyl sulfoxide (DMSO) and used to screen for antibacterial activity. Boerhavia diffusa water extract was made by weighing 100g powder and boiling it in a water bath for 24 hours with 300ml of distilled water. The water is then filtered and evaporated. The extracted material was dissolved in sterile distilled water at a concentration of 3g/4ml and tested for antibacterial activity. [7]

Sarpagandha - Rauwolfia serpentina fresh leaves were collected. Then it was simply surface-sterilized by washing with tap water and distilled water and drying in the shed for 20 days. After drying, the leaves and petals of Rauwolfia serpentine were powdered in a grinder mixer and stored for later use. [8]

Shatavari - Using a vacuum concentrator at 40°C, the plant material in powder form was fermented in distilled methanol for 72 hours, filtered and evaporated under reduced pressure under vacuum. This procedure was repeated 4 times to obtain a crude methanol extract. To obtain continuous fractions, crude methanol extracts were subjected to liquid-liquid extraction in various organic solvents. Fractionation gave hexane, dichloromethane, ethyl acetate and an aqueous fraction. The ethyl acetate fraction was subjected to silica gel column chromatography (CC). Samples were first eluted with nhexane at increasing polarity with dichloromethane (DCM) in the range of 10M to 100M. The polarity was then increased by combining methanol and DCM at concentrations in the range of 1% to 20% methanol in DCM. This procedure created 16 subfractions (AE1 through AE16). Partial fraction AE 7 was additionally purified via CC using a silicone gel. As a gradient, the sample was eluted with 4% methanol: DCM to produce compounds 1 and 2. Another subtraction AE9 was purified by CC using a silicone gel containing a mobile phase of 6% methanol:DCM to yield compounds 3 and 4. The

chemical structures of the isolated compounds were determined by comparing published mass and NMR data. [9]

III. ENCAPSULATION

Ghritkumari - To create a wound healing product, Aloe Vera extract was encapsulated in Tragacanth Gum using a sonochemical microemulsion process. FESEM/EDX and FT-IR analysis confirmed the successful formation of spherical nanocapsules by cross-linking aluminium ions with Tragacanth Gum. [10]

Amla - The extrusion process was optimised for encapsulation (bead formation) using two percentages of alginate as wall material and 0.1m CaCl2 as hardening bath. Encapsulation efficiency (ee) was highest at 500mg of ascorbic acid (74%), followed by 750 mg and 1000mg. Amla pulp had the highest ee (95 percent) at 40g. At both the ambient and refrigeration stages of storage, encapsulated ascorbic acid beads contained 3540.5mg to 3180.8mg of vitamin C per 100g of beads.[11]

Guduchi - The main chemical constituents of this shrub are alkaloids with nitrogen heterocycles such as troplate alkaloids, azole derivatives, piperidines and pyridines. Indole alkaloids other than isoprene; and similar carriers with alkaline term diabetic properties. Nanoparticles (NPs) are created by evaporation of biodegradable poly (D, lactide) (PLA) polymers and solvents. The nanoparticles were then characterized using spectroscopy, X-ray diffraction and scanning electron microscopy. We studied the release curve and retention efficiency of NP. We also tested the inhibitory activity of synthetic nanoparticles for antidiabetic potential and compared them with the binding results. In this research,. The results show that TC stem extract has a therapeutic effect on diabetes. Compared to compounds in mass spectrometry, the insulin receptor-cabos interaction has the lowest binding affinity, which acts as an insulin activator and is responsible for the inhibitory effect of α-glucosidase. You need to be careful. [12]

Ashwagandha - Phytosomes have higher absorption and bioavailability than traditional herbal extracts. Ashwagandha Phytosomes were created by binding standardised plant extract to phospholipids, resulting in a lipid compatible molecular complex. Particle size, zeta potential, scanning electron microscopy (SEM), Fourier transforms infrared spectroscopy, and in vitro drug release were used to characterise ashwagandha phytosome complexes. The average particle size and zeta potential of the optimised Ashwagandha phytosomes formulation were 98.4nm and 28.7 mV, respectively.In vitro drug release studies revealed that the cumulative percent drug release of Ashwagandha phytosome capsules was 76.8 percent. The reducing power method was used to assess the antioxidant activity of Ashwagandha phytosomes. The results revealed that the Ashwagandha phytosome complex had higher antioxidant activity than the Ashwagandha extract. As a result, it was determined that Ashwagandha phytosomes are a useful novel drug delivery system with higher bioavailability than conventional formulations. [13]

Arjuna - Microcapsules with alcoholic Arjuna extract were created. In a nutshell, maltodextrin (80 g/L) and gum arabic (20 g/L) dispersions were made by dissolving them in distilled water. These dispersions were then combined with 2% Alcoholic Arjuna extract, which was then mixed for 1 hour with a magnetic stirrer to form a homogeneous mixture. To form microcapsules, the mixture was homogenised using a high shear mixture (IKA-T25, Ultra Turrax, Germany) at 4000 rpm for 5 minutes. The mixture was then dried in a tray dryer at 50 °C. The resulting Arjuna microcapsule powder was stored in amber-colored bottles at 5°C until use. [14]

Bramhi - Bacopa monnieri's Shooting Chips For the shooting start, the shooting chips encapsulated in sodium alginate were mixed with 6 benzylaminopurine (BAP), kainezine, zeatine 1 naphthalene acetic acid (NAA), indole-3-acetic acid (IAA), and indole 3 Cultured in Murashigesukugu (MS) medium containing butyric acid (IBA).). The effects of SLE in Gracilariasalicornia and Kappaphycusalvarezii (20-80%) on the induction and reproduction of shoots using the tip of a shoot were also evaluated. After 5 weeks of incubation, MS medium with 1.0 mg L1BAP and 0.5 mg L1 NAA showed the highest multiple shoot induction frequency of 95.8%, an average of several 147.8 and an average length of 12.5 cm shoots, whereas 60% of G. Multiple shot inducements of 85.9 percent with an average length of 12.3 cm. Semi-strength MS medium containing 25% G, containing 0.1 mg L1 IAA. The effective rooting frequency of salicornia extract, 84.1%, was observed 1 week after culturing. [15]

Punarnava - Based on the planar chromatographic method (HPTLC) with optimized Toluene: ethyl acetate: ethyl acetate: ethyl acetate: ethyl acetate formic acid: methanol (5:3:1:1 v/v).Further densitometry and marker quantification of the developed plate was carried out at ultraviolet 254 nm. Presented in the form of comparative characteristic HPTLC fingerprints and densitograms with well-resolved prominent bands for boeravinone-B at retardation factor (Rf) – 0.87 in both the samples. The linear regression by calibration plots revealed a good linear relationship with 0.99953 with a standard deviation of 0.74% for the area in the concentration range of 200–1000 ng/spot. Statistical analysis proves that the developed quantification method is reproducible and selective. Findings showed the presence of 0.055% and 0.012% w/w boeravinone-B in a hydroalcoholic extract of B. diffusa and its polyherbal formulation, respectively, at R f0.87 under λ 254 nm. The study established fast, simple, precise, and cost-effective methods for qualitative and quantitative studies of Ayurvedic raw drugs, and polyherbal formulations consist of B. diffusa. It estimated boeravinone-B in raw drug (ingredient) as well as in its polyherbal formulation. The study qualitatively and quantitatively authenticated the presence and ratio of B. diffusa in polyherbal dosage form (capsule). Moreover, it suggested that the plant contains a rich amount of

boeravinone-B; this may be directed in the selection of genuine plant species in formulation development as well as in standardization. [16]

Sarpagandha - The encapsulated shoot tips were transferred to modified MS medium supplemented with varied sucrose concentrations (0.3, 0.5, and 0.7 M). The encapsulated shoot-tips were transferred on sterile filter paper in uncovered Petri dishes for varied time durations (3, 5, 7, or 9 hours) under a laminar airflow cabinet at room temperature after 24 hours of incubation on a rotary shaker (100 rpm) at 25°C. [17]

Shatavari - Liposomes were prepared using various methods, including chloroform film (CF), reverse phase evaporation (REV), polyol dilution (PD), and freeze-drying of single-phase solution (MFD). The weight ratio of AR16 to lipid is 1:10, lecithin (LEC). or Phospholipon®90G (PC90G) as a phospholipid with a molar ratio of 7:3 in CHOL. The results showed that the CF and MFD vesicles were multi-layered, whereas the REV and PD vesicles were oligolamera with particle sizes ranging from 0.26 to 13.83 m. Zeta potentials ranged from 1.5 to 39.3 mV. AR16 liposomes containing LEC showed much higher capture rates than those containing PC90G. Liposomes containing LEC and prepared using the PD method had the best capture efficiency and invitro tyrosinase inhibitory activity of 69.08 percent and 25 percent, respectively. LEC>PC90G and PD>CF>REV>MFD showed the highest tyrosinase inhibitory activity. For each preparation method, the mechanism of vesicle formation is the most important factor influencing the physicochemical properties, in particular the type, size, surface charge and entrapment of vesi crud, and could be well linked and concluded with all these biological activities. [18]

IV. BIO COMPONENTS OF DIFFERENT HERBS

Sl. No.	Herb	Scientific name	Bio components
1.	Ghritkumari	*Aloe vera*	• Vitamins: It contains vitamins A, C, and E, B12, folic acid, and choline. • Enzymes: Aliiase, alkaline phosphatase, amylase, bradykinase, carboxypeptidase, catalase, cellulase, lipase, and peroxidase. Bradykinase. • Minerals: Calcium, chromium, copper, selenium, magnesium, manganese, potassium, sodium, and zinc. • Anthraquinones: Aloin and emodin • Hormones: Auxins and gibberellins that help in wound healing and have anti-inflammatory action.[19]
2.	Amla	*Phyllanthus emblica*	• Ascorbic acid (vitamin C)[20] • Emblicanin A (37%), Emblicanin B (33%), Punigluconin (12%), and Pedunculagin (14%). [21] • Punicafolin and Phyllanemblinin A, Phyllanemblin other Polyphenols, flavonoids, kaempferol, ellagic acid, and gallic acid.[22][23]
3.	Guduchi	*Tinospora cordifolia*	• Columbin, tinosporaside, jatrorhizine, palmatine, berberine,tembeterine, tinocordifolioside, phenylpropene disaccharides, choline, tinosporic acid, tinosporal, tinosporon, and tinosporide.[24][25]
4.	Ashwagandha	*Withania somnifera*	• withanolides – which are triterpene • lactones – withanolides, withaferin A, alkaloids, steroidal lactones, tropine, and cuscohygrine. {26] • Some 40 withanolides, 12 alkaloids, and numerous sitoindosides have been isolated.[27]
5.	Arjuna	*Terminalia arjuna*	• Tannins, triterpenoid saponin (arjunic acid, arjunolic acid, arjungenin, andarjunglycosides). • Flavonoids (arjunone, arjunolone, luteolin), gallic acid, ellagic acid, Oligomeric Proanthocyanidines (OPCs), phytosterols • Calcium, magnesium, zinc, and copper.[28]
6.	Brahmi	*Bacopa monnieri*	• Dammarane-type triterpenoid saponins known as bacosides, with jujubogenin or pseudo-jujubogenin moieties as aglycone units. [29] • Bacopasides [30] • Brahmine, nicotine, and herpestine have been catalogued, along with D-mannitol, apigenin, hersaponin, monnierasides I–III, cucurbitacin, and plantainoside B.[31][32]
7.	Punarnava	*Boerhavia diffusa*	• Boerhaavia G and Boerhavia H are two rotenoids isolated from B. diffusa. A quinolone alkaloid, lunamarine, isolated from B. diffusa, BDP-30. [33][34][35]
8.	Sarpagandha	*Rauvolfia serpentina*	• Ajmaline, ajmalicine, reserpine, and serpentine.[36]

9.	Shatavari	*Asparagus racemosus*	• Asparagamine A, Steroidal saponins, shatavaroside A, shatavaroside B, filiasparoside C, shatavarins, immunoside, and schidigerasaponin D5 (or asparanin A), isoflavone 8-methoxy-5,6,4'-trihydroxyisoflavone 7-O-β-D-glucopyranoside.[37][38][39][40]

V. FUNCTIONAL FOOD

From concept to successful market implementation, functional food development involves several distinct stages. The current review's goal is to define the processes involved in each of these stages, beginning with the translation of an essential concept into an acceptable, marketable prototype. Such prototypes must then be evaluated for efficacy and safety using animal and human proof-of-concept testing. The publication of efficacy and safety data boosts the credibility of functional food products, which leads to increased consumer awareness, which also serves as the foundation for regulatory approval and the development of health claims. Consumer acceptance and provision of health claims leads to increased market penetration of functional food entities, which in turn stimulates initiatives for the development of new products in the same cycle. [41]

Ghritkumari - Aloe vera jam help in providing nourishment as well as the therapeutic benefits of Aloe vera.[42]

Amla - Amla fruits were selected for the processing of Amla Candy. Fruits were blanched in boiling water for 10 min. It can be concluded that sorbitol syrup concentration treatments (45Bx, 50Bx, and 70Bx) in combination with a 02 percent alum pretreatment are suitable for improving candy quality. Finally, the prepared candies can be stored properly in a standing pouch for up to 02-03 months without losing their sensory quality attributes. Amla Candy is a nutraceutical-rich product & provides low calories combined with additional health benefits as a result of an appreciable amount of mineral content.[43]

Guduchi - Guduchi in Chyawanprash is a superior, nutritious, and safe health tonic that is beneficial for all age groups and genders. It is an Ayurvedic superfood and healer par excellence that strengthens the immune system and revitalises the psychosomatic system. [44]

Ashwagandha - Ashwagandha is used on a large scale as a natural health supplement. Leaves and roots of Ashwagandha (dose: 3-6 gm) can be used in powder form or as it is in the food formulations. Several products are developing by researchers, incorporated with Ashwagandha such as shrikhand, namakpara, missi roti, chutney, muruku, etc. to get medicinal benefits.[45]

Arjuna - Arjuna herb, sugar, and cocoa powder are a desirable combination of ingredients were added. Arjuna was added in encapsulated form. It containing the efficacy of the herb and its nutraceutical values. [46]

Brahmi - Brahmi has been shown in clinical studies to have functional and therapeutic benefits. It is used as a functional ingredient in the vast majority of commercial food products such as Paradise Gold Premium Brahmi Almond Syrup, Panchwati Health Prash, Ojasvita, and others. [47]

Punarnava - Punarnava is also used to treat ophthalmic disorders, with the Sharangadharasamhita recommending a collerium (anjana) for itching made by combining churna with milk; mixed with honey to treat ophthalmic discharges; mixed with ghee for corneal wounds; mixed with taila for poor vision; and mixed with rice water (kanjika) for night blindness. [48]

Sarpagandha - Sarpagandha Ghana Vati improved the majority of the variables and was comparable. Variables such as SBP, DBP, MAP, Hamilton anxiety rating scale, subjective sleep profiles, and total cholesterol all improved.Sarpagandha Ghana Vati produced a reduction in total cholesterol and LDL. The assessment of serum creatinine levels revealed that both groups had good safety profiles. [49]

Shatavari - Shatavari incorporated with bread for better acceptability with enhanced functionality. Important in terms of incorporating functional attributes into bakery products for a more nutritional role. [50]

VI. ANTIVIRAL ACTIVITY

Sl.No.	Herb	Scientific name	Antiviral Activity
1.	Ghritkumari	*Aloe vera*	Aloe vera shows activity against HSV(Herpes simplex virus).
2.	Amla	*Phyllanthus emblica*	Its antiviral properties against the influenza virus
3.	Guduchi	*Tinospora cordifolia*	It supports the treatment of opportunistic infection against HIV patients
4.	Ashwagandha	*Withania somnifera*	It shows antiviral activity against HCV(Hepatitis C Virus).
5.	Arjuna	*Terminalia arjuna*	Arjuna shows activity against HSV(Herpes simplex virus).
6.	Brahmi	*Bacopa monnieri*	Brahmi shows activity against HSV(Herpes simplex virus).
7.	Punarnava	*Boerhavia diffusa*	Punarnava shows activity against the HSV-2.
8.	Sarpagandha	*Rauvolfia serpentina*	Sarpagandha shows antiviral activity against influenza and herpes
9.	Shatavari	*Asparagus racemosus*	Shatavari shows activity against the HSV-2.

VII. CONCLUSION

The herbs that are discussed here are extracted and encapsulated using various methods. Then the functional foods are developed which consists of all biocomponents. The efficacy of the biocomponents was retained so the food bears all the nutritional components. These herbs show antiviral activity and are also effective against other diseases.

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