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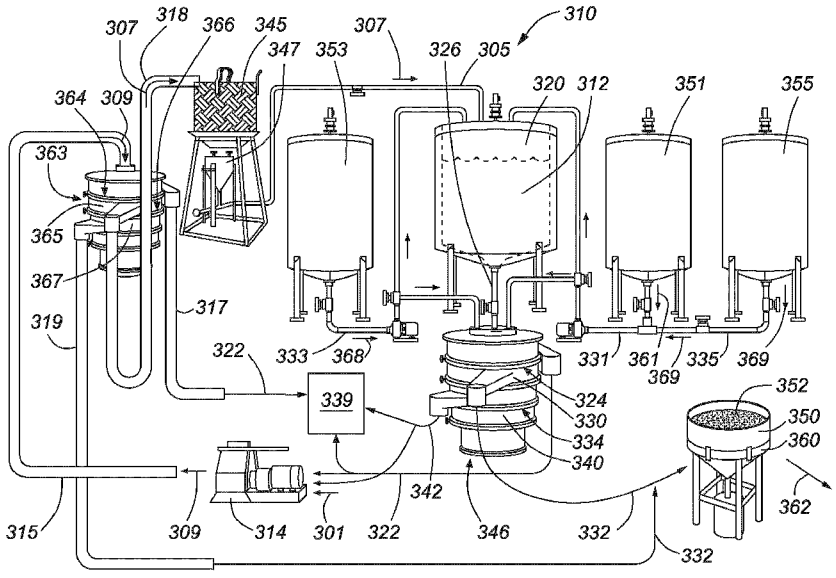

FIG. 5

(57) Abstract: A method and system for isolating trichomes from plant matter. The method and system are applied to biomass including trichomes bound to structural plant material. The biomass is combined with a solution including a chelating agent for loosening chemical bonds that include cations, and that bind trichomes to the structural plant matter. The biomass is agitated in the solution for separating the trichomes from the structural plant material. After agitation, the solution is filtered to remove the structural plant material and at least a portion of the solution from the trichomes. Any remaining solution may be separated from the trichomes by further dewatering. The separated trichomes may be dried and pressed into pellets. The separated trichomes may be rinsed with a solution comprising a reducing agent.

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METHOD AND SYSTEM FOR TRICHOME ISOLATION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of priority of United States Provisional Patent Application No: 62/860,302 and entitled METHOD AND SYSTEM FOR TRICHOME ISOLATION and filed June 12, 2019, which is hereby incorporated by reference in its entirety.

FIELD

[0002] The present disclosure relates to isolation of trichomes from other biomass.

BACKGROUND

[0003] Regulated extraction of phytocannabinoids, terpenoids and isopropanoids and other compounds from *Cannabis sativa* flowers has opened up an entire regulated industry in North America and elsewhere. Drug-type varieties of *C. sativa* rich in delta-9-tetrahydrocannabinol ("**THC**"), cannabidiol ("**CBD**") or other phytocannabinoids, are typically cultivated in greenhouses or indoor growing systems at relatively small scales of between a few thousand and several hundred thousand square feet of canopy. In contrast, industrial hemp approved cultivars of *C. sativa* are regulated in most jurisdictions to a maximum 0.3% or less THC in flowering tops and leaves, but have no regulated limits on CBD or other phytocannabinoids.

[0004] Extraction of CBD from hemp crops at scale presents new operational challenges. It is expected millions of hectares of hemp are to be planted for processing in North America alone. Currently approved cultivars of hemp have relatively low concentrations of CBD in dried flowers compared with drug-type varieties that produce significant amounts of CBD. As a result, extraction of CBD from biomass sourced from hemp is much more dependent on scale for profitability

than is extraction from drug-type cultivar biomass, whether rich in THC, CBD or other phytocannabinoids.

[0005] A significant challenge facing the hemp flower industry is handling thousands of tonnes of biomass for processing during fall harvest. Due to the large quantities that are projected to be grown and harvested in the next few years, effective drying of wet biomass presents a core logistical problem. During the limited window available for outdoor harvest, hundreds of kilograms per hectare of wet flowers are harvested. With current approaches, processing even a handful of farmer's harvests simultaneously requires huge drying facilities and infrastructure with large capital expense.

[0006] For extraction, the biomass must be dried from about 80% relative humidity ("**RH**") at harvesting to between 5 and 7% RH for extraction. This has to be done in a short period of time before microorganisms propagate in the wet biomass. Drying the cut biomass by laying it on the soil to dry is not an option as contamination risk increases. Chemical drying sprays may be effective for seed crops, but none currently exist for hemp flower drying. As hemp flower harvesting technology becomes more efficient, the rate of harvest may increase, compounding the problem. As a result, downstream equipment needs to evolve as well.

[0007] Current large-scale drying options for massive hemp flower harvest management have significant drawbacks. Hot air belt conveyor dryers, natural gas chamber dryers, vacuum freeze dryers and microwave dryers commonly used to dry biomass to prepare the biomass for extraction.

[0008] Air drying can take a significant amount of time and requires tight control. Increasing temperature and reduce the ambient humidity is required to air dry. As a result, significant amounts of external energy must be provided to the biomass, with more input energy accelerating the process. Rapid drying of the biomass to prevent spoilage must be balanced with increased energy usage and other costs. A tight harvest schedule of thousands of tonnes may not allow the time necessary for slow ambient air drying in a reasonably sized facility. Air drying also

requires a large amount of indoor space that is not normally available on most farms or processing sites.

[0009] Drying hemp in a field by laying it on the soil after combine-cutting may increase the chances of spoiling the biomass.

[0010] Most farm seed dryers are designed to remove a small amount of humidity from seed, and may be applied to passing dry hot air through the biomass to remove humidity. With this approach, drying speed must be balanced with avoiding significant loss of phytocannabinoids and other valuable compounds through vaporization. Vaporizing water requires supplying enough energy to exceed the latent heat of vaporization, while remaining below the vaporization temperatures of volatile organic compounds such as phytocannabinoids, terpenoids and isopropanoids.

[0011] Mesh belt dryer machines designed for green biomass drying may overheat the biomass, vaporizing phytocannabinoids, terpenoids and isopropanoids. To continuously dry the hemp flower on a conveyor, motivation to minimize the temperature of the hot air must be balanced with motivation to quickly dry the plant matter. In some cases, the required width and depth of the conveyors may be impractical to dry the biomass, and the heat required may vaporize phytocannabinoids, terpenoids and isopropanoids.

[0012] Commercial tray drying ovens for wood, fruit or vegetable dehydration heat raw material on wire trays in a hot oven with hot air circulation. Moisture drawn out from the material is exhausted outside the drying chamber. Some the phytocannabinoids, terpenoids and isopropanoids may be vaporized with this approach. In addition, throughput may not be high enough to process thousands of tonnes of biomass in only a few days of outdoor harvest.

[0013] Vacuum freeze dryers facilitate retaining phytocannabinoids, terpenoids and isopropanoids through drying by lowering the temperature and pressure. However, these approaches may be cost-prohibitive at a multi-tonne scale of drying of flower per day would. The simultaneous volume harvested by only a few farmers may be too expensive to justify based on the limited revenue generated by the CBD and other chemicals in the flowers.

SUMMARY

[0014] As in the background above, given the rapidity with which large amounts of *Cannabis sativa* flowers, leaves and other biomass including phytocannabinoids, terpenoids and isopropanoids are harvested as inputs for extraction, there is motivation to improve the efficiency of harvesting such biomass for extraction.

[0015] Herein described is a method and system for isolating trichomes from other biomass. This approach can be applied to *C. sativa* flowers or biomass sourced from other species of plant, including where applicable, phytocannabinoids, such species including *Humulus lupulus* (hops), *Pelargonium hortorum* (geraniums), plants in the *Asteraceae* family (chamomile) and others.

[0016] The method and system described herein reduce the volume of biomass to be dried and processed relative to intact harvested flowers and other biomass. By isolating the trichomes from the leaves, calyxes and bracts, a majority of the phytocannabinoids, terpenoids, isopropanoids and other compounds are retained while the biomass volume to be dried is reduced significantly, in some cases by over 90%. The trichomes contain the majority of the phytocannabinoids, terpenoids, isopropanoids, and other terpenophenolics of value. As a result, isolating trichomes from other biomass allows for significant reduction of the total mass of plant matter to be dried and extracted. By drying, extracting from and other wise processing only trichomes, and not the entire flower, the cost per kg of phytocannabinoids, terpenoids, isopropanoids and other compounds isolated is reduced. Excluding biomass that lacks compounds of interest reduces the volume of throughput and energy, and the corresponding financial and environmental burden, required per kg of compounds of interest. As efficiency of extraction increases, fewer runs are required per kg of isolated compounds of interest. Application of the method and system at the harvest site also reduces the cost of transportation per hectare of harvest.

[0017] The method includes, and the system facilitates, chilling a solution at a pH between a neutral pH and an alkaline pH, the solution including a chelating agent and a reducing agent. The solution may be buffered to the target pH. A higher pH solution may soften the lignin of the trichome stalk, and may make the stalk easier to break or digest, releasing the trichome head. The plant biomass is added in the chilled solution with the chelating agent for disrupting the middle lamella of the plant epidermal tissue at the trichome connection between trichome head cells and trichome stalk cells. The plant biomass may be soaked in the chilled solution or may be ground immediately upon addition to the chilled solution. After the optional soaking in the chilled solution or upon addition to the chilled solution, the plant biomass may be ground, which will further separate trichome head cells from stalk cells. A grinding agent may be added and agitation used to increased contact between the grinding media and the plant biomass. After grinding, the solution is passed through a coarse filter, such as one having a pore size of about 250 µm, to hold back the plant matter and the grinding media. After coarse filtering, the solution is passed through a fine filter, such one having a pore size of about 25 µm, to hold back trichomes and remove the buffered solution. Any solution remaining in the trichomes may be dewatered, such as with a centrifuge. Trichomes remaining after dewatering may be pelletized to simplify handling of the trichomes. Drying may be applied after dewatering and before or after pelletizing. Drying may include air drying or baking, including low-temperature baking.

[0018] In another example method, disruption of pectin to improve extraction of trichome heads may be applied with steps of chilling a processing solvent including water buffered to a pH of between 7.0 and 14.0 to a temperature of between 2 and 6 °C, adding a chelating agent such as EDTA at a concentration sufficient to disrupt the middle lamella of the plant epidermal tissue, especially the trichome connection between cells of the head and cells of the stalk, adding a grinding agent such as polycarbonate grinding media larger than 250 µm, or dry ice fragments larger than 250 µm to more readily and consistently break the trichome head from the stalk or from the non-epidermal tissues, applying agitation to increase the contact between

the grinding media and the cold trichomes in the fluid, applying primary filtration of a coarse mesh sieve filter with a coarse pore size, such as about 250 µm, to retain large plant matter and the grinding media, applying secondary filtration of a fine mesh sieve filter with a fine pore size, such as about 25 µm, to retain the trichomes and allow the buffered solvent solution containing chelating agent to pass through, dewatering, such as centrifugation at low enough g-force to remove as much solution without damaging the trichomes, pelletizing using a pellet mill to compress and cut the trichome mass into a uniform size, and drying by either air drying on a wire mesh tray, using a vacuum freeze dryer, or gentle warm air dryer to stabilize the trichomes for longer term storage. A reducing agent such as L-cysteine may be added to the trichomes to mitigate oxidation of the phytocannabinoids or other compounds in the trichomes. The reducing agent may be added to the processing solvent at a concentration sufficient to mitigate oxidation of the phytocannabinoids by the solution. The reducing agent may be added to the dried trichomes, either before or after pelletizing by pouring a solution of the reducing agent through the dried trichomes.

[0019] In a first aspect, herein provided is a method and system for isolating trichomes from plant matter. The method and system are applied to biomass including trichomes bound to structural plant material. The biomass is combined with a solution including a chelating agent for loosening chemical bonds that include cations, and that bind trichomes to the structural plant matter. The biomass is agitated in the solution for separating the trichomes from the structural plant material. After agitation, the solution is filtered to remove the structural plant material and at least a portion of the solution from the trichomes. Any remaining solution may be separated from the trichomes by further dewatering. The separated trichomes may be dried and pressed into pellets. The separated trichomes may be rinsed with a solution comprising a reducing agent.

[0020] In a further aspect, herein provided is a method of isolating trichomes from structural plant matter comprising: providing biomass comprising trichomes bound to structural plant material; combining the biomass with a solution comprising

a chelating agent; agitating the solution and the biomass for separating the trichomes from the structural plant material; and filtering the solution to remove the structural plant material and at least a portion of the solvent from the trichomes for providing isolated trichomes.

[0021] In some embodiments, the biomass has been dried following harvest. In some embodiments, providing the biomass comprises milling raw biomass. In some embodiments, milling the raw biomass comprises milling the raw biomass at a temperature of -20 °C or lower. In some embodiments, combining the biomass with the solution comprises combining the biomass with the solution at a chilling temperature of between 2 °C and 6 °C. In some embodiments, the chilling temperature is 4 °C. In some embodiments, the solution comprises a base for providing a pH above 8.0. In some embodiments, the base comprises NaOH. In some embodiments, the solution comprises a buffer for maintaining a selected pH. In some embodiments, the selected pH is between 6.5 and 14.0. In some embodiments, the selected pH is between 7.5 and 13.5. In some embodiments, the selected pH is between 8.5 and 13.0. In some embodiments, the selected pH is between 9.5 and 12.5. In some embodiments, the selected pH is between 10.5 and 12.0. In some embodiments, the selected pH is between 11.0 and 11.5. In some embodiments, the solution comprises a reducing agent for maintaining the quality of the trichomes. In some embodiments, the reducing agent comprises L-cysteine. In some embodiments, combining the biomass with the solution comprises soaking the biomass in the solution. In some embodiments, soaking the biomass comprises soaking the biomass at a soaking temperature of between 2 °C and 6 °C. In some embodiments, the soaking temperature is 4 °C. In some embodiments, the method includes, prior to agitating the solution, adding a grinding material to the solution. In some embodiments, filtering the solution comprises filtering the solution to remove the grinding material. In some embodiments, the grinding material comprises dry ice. In some embodiments, agitating the solution comprises agitation at an agitation temperature of between 2 °C and 6 °C. In some embodiments, the agitation temperature is 4 °C. In some embodiments, agitating the solution comprises

application of an agitator selected from the group consisting of a continuous flow agitator, a rotary agitator, a static mixer, an inline high sheer rotor stator homogenizer, a shaker, a vortex mixer, a wafer mixer, a homogenizer, a liquid jet mixing nozzle and a venturi tube fluid jet. In some embodiments, agitating the solution comprises application of rotary flow to the biomass solution. In some embodiments, agitating the solution comprises application of turbulent flow to the biomass solution. In some embodiments, agitating the solution comprises application of laminar flow to the biomass solution. In some embodiments, filtering the solution comprises filtering the solution with a coarse filter to filter the structural plant material from the trichomes and the solution; and filtering the solution with a fine filter to filter the trichomes from the solution for providing the isolated trichomes. In some embodiments, the coarse filter comprises a pore size of between 150 and 250 µm and the fine filter comprises a pore size of between 25 µm and 75 µm. In some embodiments, the coarse filter comprises a 200 µm filter and the fine filter comprises a 50 µm filter. In some embodiments, the method includes dewatering the isolated trichomes to remove residual solvent from the isolated trichomes. In some embodiments, dewatering the isolated trichomes comprises one or more of centrifuging, vacuum filtering, filter pressing, screw pressing, applying a drying bed to, applying a slurry separator to, or applying a dewatering screen to the isolated trichomes and the residual solution. In some embodiments, the method includes, after dewatering the isolated trichomes, pelletizing the isolated trichomes to provide trichome pellets. In some embodiments, the method includes drying the trichome pellets. In some embodiments, pelletizing the isolated trichomes comprising rinsing the isolated trichomes with a reducing agent solution. In some embodiments, the reducing agent solution comprises L-cysteine. In some embodiments, the method includes, after dewatering the isolated trichomes, drying the isolated trichomes. In some embodiments, the method includes, after dewatering the isolated trichomes, rinsing the isolated trichomes with a second solvent for rinsing the chelating agent out of the isolated trichomes In some embodiments, the second solvent comprises water without EDTA and without buffer. In some embodiments, rinsing the isolated

trichomes comprises rinsing the isolated trichomes at a rinse temperature of between between 2 °C and 6 °C. In some embodiments, providing biomass includes filtering untreated biomass with a pre-treatment coarse filter to filter at least a portion of the structural plant material from the trichomes, filtering the untreated biomass with a pre-treatment fine filter to at least a portion of the trichomes from the untreated biomass for providing the biomass; the pore size of the pre-treatment coarse filter is greater than the pore size of the coarse filter; the pore size of the pre-treatment fine filter is smaller than the pore size of the fine filter. In some embodiments, the pre-treatment coarse filter comprises a pore size of between 150 and 250 µm and the pre-treatment fine filter comprises a pore size of between 25 µm and 75 µm. In some embodiments, the pre-treatment coarse filter comprises a 200 µm filter, the pre-treatment fine filter comprises a 50 µm filter, the coarse filter comprises a 150 µm filter, the fine filter comprises a 75 µm filter. In some embodiments, the method includes combining a surfactant with the solution for breaking connections in the cell walls of the plant matter between the structural plant matter and the trichomes. In some embodiments, the surfactant comprises sodium dodecyl sulfate. In some embodiments, the method includes rinsing the isolated trichomes with a reducing agent solution. In some embodiments, the reducing agent solution comprises L-cysteine. In some embodiments, the method includes, after agitating the solution and the biomass for separating the trichomes from the structural plant material, repeating the method wherein combining the biomass with the solution comprises combining the structural plant material with the solution. In some embodiments, the method includes, after filtering the solution to remove the structural plant material and at least a portion of the solvent from the trichomes for providing isolated trichomes, repeating the method wherein combining the biomass with the solution comprises combining the structural plant material with the solution.

[0022] In a further aspect, herein provided is a system for isolating trichomes from structural plant matter comprising: a mixing tank for receiving biomass comprising trichomes bound to structural plant material and a solution comprising a chelating agent; an agitator in communication with the mixing tank for agitating the

solution to separate the trichomes from the structural plant material; a coarse filter in fluid communication with the mixing tank for removing the structural plant material from the trichomes and the solution; and a fine filter in fluid communication with the mixing tank downstream of the coarse filter for removing the at least a portion of the solution from the trichomes and providing the isolated trichomes.

[0023] In some embodiments, the agitator comprises an agitator selected from the group consisting of a continuous flow agitator, a rotary agitator, a static mixer, an inline high sheer rotor stator homogenizer, a shaker, a vortex mixer, a wafer mixer, a homogenizer, a liquid jet mixing nozzle and a venturi tube fluid jet. In some embodiments, the agitator applies flow selected from the group consisting of rotary flow, turbulent flow or laminar flow. In some embodiments, the coarse filter and the fine filter comprise a shaker sieve. In some embodiments, the coarse filter comprises a trommel. In some embodiments, the system includes a dewatering system in fluid communication with the agitator for dewatering the isolated trichomes to remove residual solution from the isolated trichomes. In some embodiments, the dewatering system comprises a system selected from the group consisting of a multidisc roller system, a belt press, a piston press, inline filters, an auger screw press, a gravity thickener, a dewatering centrifuge, a vacuum filter, a filter press, a sludge screw press, a screw press separator, a drying bed, a solid liquid separator, a slurry separator, dewatering equipment and a dewatering screen. In some embodiments, the system includes a cryogenic hammer mill in communication with the mixing tank for pulverizing raw biomass to produce the biomass and providing the biomass to the mixing tank. In some embodiments, the system includes a water agent tank for providing water to the mixing tank. In some embodiments, the system includes a chelating agent tank for providing the chelating agent to the mixing tank. In some embodiments, the system includes a base tank for providing a base to the mixing tank for increasing a pH value of the solution. In some embodiments, the system includes a surfactant tank for providing surfactant to the mixing tank. In some embodiments, the system includes a venturi downstream of the mixing tank and upstream of the coarse filter for separating the trichomes from the structural plant

matter. In some embodiments, the system includes a static mixer downstream of the mixing tank and upstream of the coarse filter for separating the trichomes from the structural plant matter. In some embodiments, the system includes a turbulent bash tube downstream of the mixing tank and upstream of the coarse filter for separating the trichomes from the structural plant matter. In some embodiments, the system includesa trommel downstream of the mixing tank and upstream of the coarse filter, the trommel comprising a pore size greater than the pore size of the coarse filter for filtering out structural plant matter upstream of the coarse filter. In some embodiments, the system includes, upstream of the mixing tank, a pre-treatment coarse filter for removing at least a portion of the structural plant material from the trichomes and a pre-treatment fine filter to filter the trichomes from the untreated biomass for providing the biomass; the pore size of the pre-treatment coarse filter is greater than the pore size of the coarse filter; the pore size of the pre-treatment fine filter is smaller than the pore size of the fine filter. In some embodiments, the pre-treatment coarse filter comprises a pore size of between 150 and 250 µm and the pre-treatment fine filter comprises a pore size of between 25 µm and 75 µm. In some embodiments, the pre-treatment coarse filter comprises a 200 µm filter, the pre-treatment fine filter comprises a 50 µm filter, the coarse filter comprises a 150 µm filter, the fine filter comprises a 75 µm filter.

[0024] In a further aspect, herein provided is a method of isolating trichomes from structural plant matter including providing biomass comprising trichomes bound to structural plant material; combining the biomass in a solution at a pH of between 8.0 and 14.0 and a chelating agent; agitating the solution at an agitation temperature of between 2 °C and 6 °C for separating the trichomes from the structural plant material; filtering the solution comprises filtering the solution with a coarse filter to filter the structural plant material from the trichomes and the solution; and filtering the solution with a fine filter to filter the trichomes from the solution for providing the isolated trichomes.

[0025] In some embodiments, the biomass has been dried following harvest. In some embodiments, providing the biomass comprises milling raw biomass. In

some embodiments, milling the raw biomass comprises milling the raw biomass at a temperature of -20 °C or lower. In some embodiments, combining the biomass with the solution comprises combining the biomass with the solution at a chilling temperature of between 2 °C and 6 °C. In some embodiments, the chilling temperature is 4 °C. In some embodiments, the solution comprises a base for providing the pH of 8.0 to 14.0. In some embodiments, the base comprises NaOH. In some embodiments, the solution comprises a buffer for maintaining a selected pH. In some embodiments, the selected pH is between 6.5 and 14.0. In some embodiments, the selected pH is between 7.5 and 13.5. In some embodiments, the selected pH is between 8.5 and 13.0. In some embodiments, the selected pH is between 9.5 and 12.5. In some embodiments, the selected pH is between 10.5 and 12.0. In some embodiments, the selected pH is between 11.0 and 11.5. In some embodiments, the solution comprises a reducing agent for maintaining the quality of the trichomes. In some embodiments, the reducing agent comprises L-cysteine. In some embodiments, combining the biomass with the solution comprises soaking the biomass in the solution. In some embodiments, soaking the biomass comprises soaking the biomass at a soaking temperature of between 2 °C and 6 °C. In some embodiments, the soaking temperature is 4 °C. In some embodiments, the method includes, prior to agitating the solution, adding a grinding material to the solution. In some embodiments, filtering the solution comprises filtering the solution to remove the grinding material. In some embodiments, the grinding material comprises dry ice. In some embodiments, agitating the solution comprises application of an agitator selected from the group consisting of a continuous flow agitator, a rotary agitator, a static mixer, an inline high sheer rotor stator homogenizer, a shaker, a vortex mixer, a wafer mixer, a homogenizer, a liquid jet mixing nozzle and a venturi tube fluid jet. In some embodiments, agitating the solution comprises application of rotary flow to the biomass solution. In some embodiments, agitating the solution comprises application of turbulent flow to the biomass solution. In some embodiments, agitating the solution comprises application of laminar flow to the biomass solution. In some embodiments, the coarse filter comprises a pore size of between 150 and 250 µm

and the fine filter comprises a pore size of between 25 µm and 75 µm. In some embodiments, the coarse filter comprises a 200 µm filter and the fine filter comprises a 50 µm filter. In some embodiments, the method includes dewatering the isolated trichomes to remove residual solvent from the isolated trichomes. In some embodiments, dewatering the isolated trichomes comprises one or more of centrifuging, vacuum filtering, filter pressing, screw pressing, applying a drying bed to, applying a slurry separator to, or applying a dewatering screen to the isolated trichomes and the residual solution. In some embodiments, the method includes, after dewatering the isolated trichomes, pelletizing the isolated trichomes to provide trichome pellets. In some embodiments, the method includes drying the trichome pellets. In some embodiments, pelletizing the isolated trichomes comprising rinsing the isolated trichomes with a reducing agent solution. In some embodiments, the reducing agent solution comprises L-cysteine. In some embodiments, the method includes, after dewatering the isolated trichomes, drying the isolated trichomes. In some embodiments, the method includes, after dewatering the isolated trichomes, rinsing the isolated trichomes with a second solvent for rinsing the chelating agent out of the isolated trichomes In some embodiments, the second solvent comprises water without EDTA and without buffer. In some embodiments, rinsing the isolated trichomes comprises rinsing the isolated trichomes at a rinse temperature of between between 2 °C and 6 °C. In some embodiments, the rinse temperature is 4 °C. In some embodiments, providing biomass includes filtering untreated biomass with a pre-treatment coarse filter to filter at least a portion of the structural plant material from the trichomes, filtering the untreated biomass with a pre-treatment fine filter to at least a portion of the trichomes from the untreated biomass for providing the biomass; the pore size of the pre-treatment coarse filter is greater than the pore size of the coarse filter; the pore size of the pre-treatment fine filter is smaller than the pore size of the fine filter. In some embodiments, the pre-treatment coarse filter comprises a pore size of between 150 and 250 µm and the pre-treatment fine filter comprises a pore size of between 25 µm and 75 µm. In some embodiments, the pre-treatment coarse filter comprises a 200 µm filter, the pre-treatment fine filter

comprises a 50 µm filter, the coarse filter comprises a 150 µm filter, the fine filter comprises a 75 µm filter. In some embodiments, the method includes combining a surfactant with the solution for breaking connections in the cell walls of the plant matter between the structural plant matter and the trichomes. In some embodiments, the surfactant comprises sodium dodecyl sulfate. In some embodiments, the method includes rinsing the isolated trichomes with a reducing agent solution. In some embodiments, the reducing agent solution comprises L-cysteine. In some embodiments, the method includes, after agitating the solution and the biomass for separating the trichomes from the structural plant material, repeating the method wherein combining the biomass with the solution comprises combining the structural plant material with the solution. In some embodiments, the method includes, after filtering the solution to remove the structural plant material and at least a portion of the solvent from the trichomes for providing isolated trichomes, repeating the method wherein combining the biomass with the solution comprises combining the structural plant material with the solution.

[0026] Other aspects and features of the present disclosure will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] Embodiments of the present disclosure will now be described, by way of example only, with reference to the attached figures, in which reference numerals sharing a common final two digits refer to corresponding features across figures (e.g. the agitation 20, 120, 220, 320, 420, 520 and 620, etc.).

[0028] Fig. 1 is a schematic of a system for isolating trichomes;

[0029] Fig. 2 is a schematic of a system for isolating trichomes;

[0030] Fig. 3 is a schematic of a system for isolating trichomes;

[0031] Fig. 4 is a schematic of a jet pump used in the system of Fig. 3;

[0032] Fig. 5 is a schematic of a system for isolating trichomes;

[0033] Fig. 6 is a schematic the system of Fig. 5 in operation, showing milling and sifting of plant matter;

[0034] Fig. 7 is a schematic of a system for isolating trichomes;

[0035] Fig. 8 is a schematic the system of Fig. 7 in operation, showing simultaneous mixing of water, NaOH, EDTA and SDS;

[0036] Fig. 9 is a schematic the system of Fig. 7 in operation, showing sequential mixing of EDTA;

[0037] Fig. 10 is a schematic the system of Fig. 7 in operation, showing sequential mixing of NaOH;

[0038] Fig. 11 is a schematic the system of Fig. 7 in operation, showing sequential mixing of SDS;

[0039] Fig. 12 is a schematic the system of Fig. 7 in operation, showing rinsing of trichomes with water;

[0040] Fig. 13 of schematic of a system for isolating trichomes in operation; and

[0041] Fig. 14 of schematic of a system for isolating trichomes in operation.

DETAILED DESCRIPTION

[0042] Generally, the present disclosure provides a method and system for trichome isolation. The method and system provided herein facilitate reducing the volume of biomass to be processed for extraction, in some cases by up to 80 to 90%, while still maintaining a majority of phytocannabinoids or other terpenophenolics, terpenoids, isopropanoids and other compounds of interest that are present in trichome cells. Glandular trichomes are isolated from bulk plant matter that carries trichomes, such as calyxes, bracts and leaves. Since the trichomes contain the compounds of interest when extracting from cannabis, hops and other biomass, isolating the trichomes and extracting only from trichomes rather than from the entire biomass significantly reduces the volume of biomass to be dried and extracted for recovery of the same or a similar amount of the compounds of interest. The smaller volume of biomass reduces the burden on extraction equipment, increasing efficiency

and driving down the cost per kg of molecule of interest recovered. As efficiency of extraction equipment increases, the present method and system further accelerate improvement in efficiency of an overall system including a supply chain from harvest to finished product on a shelf. Volume reduction at the farm site also reduces the cost of transportation as fewer runs of the transportation trucks to the processors are required per hectare of harvest.

[0043] Glandular trichomes are modified epidermal hairs that produce chemical exudates. The exudates consist of a diverse group of allelochemicals associated with pest resistance in plants. The exudate chemicals are potent enough to deter a variety of otherwise persistent herbivores. The glandular cells at the tip of the trichome, the head cells, displays many ultrastructural features indicative of active metabolism and secretion, leading to the general assumption that it is the site of synthesis. See Kelsey RG et al. (1984), Wagner GJ (1991). By example, in tobacco, spearmint, geranium and hops, the trichome's exudate synthesis of compounds such as terpenoids was confirmed by biochemical evidence in Keene CK et al. (1985) and Gershenzon J (1989).

[0044] Resistance to arthropod pests is mediated by the presence of a sticky exudate on the surface of glandular trichomes, containing terpenophenolics such as phytocannabinoids, bioflavonoids and terpenoid compounds excreted after the biosynthesis of fatty acids and isoprenoids through the hexanoate, geranyl pyrophosphate, mevalonate and methylerythritol phosphate pathways. Isolation of these compounds could be achieved by isolating the structures from the plant (trichomes that contain most of the terpenophenolics), separated from tissue that do not contain sufficient amounts of the compounds of interest to necessitate drying and processing.

[0045] In peer-reviewed literature, various methods have been used to gather glandular trichomes from a variety of tissue for analysis:

[0046] (a) plant surface shaved manually with a scalpel blade;

[0047] (b) epidermal peel to remove trichome-containing fragments;

[0048] (c) coverslip wiped over projecting trichomes to collect adhering cells;

[0049] (d) cotton swab saturated with antioxidant wiped over leaflet surface to collect trichomes;

[0050] (e) tissue fragmented in a blender and cell types separated by Percoll density gradient centrifugation; and

[0051] (f) leaves tumbled in a flask with small glass beads (or in a commercial ball mill or cellular disruptor) in buffer to mechanically detach epidermal fragments containing trichomes.

[0052] Current methods are hampered by the difficulty of harvesting adequate quantities of trichome tissue. Appropriate for laboratory scale procedures, these procedures are not appropriate for processing enough tissue necessary for extraction of tonnes of trichomes from thousands of tonnes of harvested flowers and leaves. The desired result is the isolation of a trichome mass with minimal ground tissue (palisade or spongy mesophyll cells) isolated.

[0053] During harvest, a processor taking in hemp flowers, leaves and other trichome bearing biomass may receive multiple tonnes per day. Similarly, a processor taking in hops may receive multiple tonnes per day of biomass. To prevent crop loss due to mold, rot or heating, the biomass must be stabilized and stored as quickly as possible and as it is received from the field. The processor may receive wet flower or cones as soon as it is harvested, within hours from combine-cutting hemp or mechanically separating hops.

[0054] Biomass may be stabilized for storage by chilling. Immediate chilling of multiple tons of biomass at the receiving site may be carried out by placing biomass in a cold storage area. In most cases, onsite cold storage and stabilization of biomass must be carried out prior to processing. Condensation may develop on individual flowers or cones when brought out of cold storage into a warmer processing area. Condensation may favour germination and propagation of grey mold (*Botrytis cinerea*) or other dangerous molds or microorganisms. As a result, biomass should be kept chilled and dehumidified for as long as necessary until just before trichome isolation.

[0055] Current hemp processors have minimal to no temperature-controlled storage technologies beyond ambient outdoor fall/winter storage. A chiller with solvent may be applied onsite during harvesting to receive and chill the flowers or other biomass as it is harvested during harvest.

[0056] A method and system are described for the rapid isolation of plant trichomes, with emphasis on stalked glandular types as would be present in flowers and leaves. The method involves breaking chilled trichomes from larger tissue fragments with agitation in solvent containing a chelating agent at a suitable pH (e.g. EDTA at pH 7, other examples provided below, etc.) and subsequent sieving for collection of glandular heads of the trichomes.

[0057] The method and system disclosed herein isolate trichomes and trichome heads from leaves, bracts, calyxes and other trichome-bearing biomass for commercial purposes. Leaves, bracts, calyxes and residual stems are harvested, cryomilled, then applied to the method and system described herein prior to drying. The plant matter in submerged in a chilled and buffered solution containing chelating agent. This is followed by strong agitation with grinding media to detach epidermal fragments of glandular trichomes from the rest of the plant matter.

[0058] Application of the method and system disclosed herein generates large quantities of trichome heads, providing a concentrated source of phytocannabinoids and other terpenophenolics, terpenoids, isopropanoids and other chemicals, while at the same time removing a majority of non-trichome containing plant matter. The trichomes are stabilized upon buffer removal to mitigate contamination and biochemical oxidation. The goal is to remove as much plant matter with minimal secondary metabolites from subsequent processing to improve efficiency.

[0059] The biomass may be chilled by submerging the biomass in a chilled solution. With the use of a liquid chiller, biomass may be combined with chilled solution in an agitator, which may be a cryoagitator for agitating the solution at an agitation temperature that is below ambient temperature. Immediate transfer to the chilled solution facilitates stabilization of the trichomes and mitigates establishment of microbiology. The chilled solution may also cause the trichomes to become brittle,

facilitating breaking trichome heads from stalks and stalks from plant matter. Temperatures close to freezing may be applied to stabilize the biomass and to cause the trichome stalks to become brittle, such as temperatures of between 2 °C and 6 °C, or about 4 °C.

[0060] Trichome cells are connected with epidermal cells of a leaf, calyx or bract by a middle lamella, which holds cell walls together. Synthesis of pectin occurs in the late phases of mitosis when a cell plate is being formed between two daughter cells. The middle lamella is important in abscission zones and is responsible for holding cells together and contributes to the rigidity of plant tissue. The lamella includes a layer of complex polysaccharides that cements adjacent cells together. Pectin cross-links within the layer of complex polysaccharides include calcium cations bound with anionic polysaccharides.

[0061] In dicots, a primary pectin is rhamnogalacturonan I, consisting of long stretches of α1,2-linked polygalacturonic acid alternating with α1,2-linked rhamnose, with side chains of arabinose and galactose. Unsubstituted polygalacturonic acid regions of the backbones of different pectin polymers are held together by ionic bridges formed by Ca2+. During abscission, the ionic groups of the homogalacturonan regions are methylated, decreasing the negative charges to which the Ca2+ binds, thus decreasing the number of ionic bridges and compromising connections between adjacent cells in the abscission zone. Removal of Ca2+ may result in pectin degradation from epidermal tissues of the plant.

[0062] Inducing dissociation of Ca2+ from the middle lamella may facilitate efficient and more consistent removal of trichomes from leaves and bracts of *C. sativa*, or from cones and strobili of *H. lupulus*. Addition of ethylenediaminetetraacetic acid ("**EDTA**") for pH range 5 to 14, or another chelating agent (e.g. disodium EDTA for pH values of around 4, ethylene glycol-bis(β-aminoethyl ether)-N,N,N′,N′-tetraacetic acid, also known as egtazic acid ("**EGTA**") for pH values of around 7, trans-1,2-diaminocyclohexane-N,N,N′N′-tetraacetic acid ("**CDTA**") for neutral or acidic pH values, L-glutamic acid N,N-diacetic acid, tetrasodium salt ("**GLDA**") for pH values of between 6 and 14, methylglycinediacetic acid ("**MGDA**") for pH values of between 6

and 14, NTA for pH values of around 7 to 13, N-carboxymethyl-N′-(2-hydroxyethyl)-N,N′-ethylenediglycine ("**HEDTA**") for pH values of around 6 to 14, diethylenetriamine pentaacetate ("**DTPA**") for pH values of around 6 to 14, oxalic acid for pH values of around 3, malic acid for pH values of around 3, tartaric acid for pH values of around 2, sodium gluconate for pH values of around 6.5 to 7.5, sodium carbonate, citric acid for pH values of around 3.2, citric acid/trisodium citrate for pH values of around 9, aminopolycarboxylate chelating agents, Fe(III)-chelates used in agriculture, including, Fe(III)-EDTA, Fe(III)-DTPA, Fe(III)-HEDTA, Fe(III)-CDTA, Fe(III)-o,o-ethylenediamine-N,N′-bis(2-hydroxyphenylacetic acid ("**EDDHA**"), Fe(III)-o,pEDDHA, and Fe(III)-ethylendiamine di(2-hydroxy-4-methylphenylacetic) acid ("**EDDHMA**") etc.), disrupts the middle lamella.

[0063] The chilled solution may include a chelating agent and a buffer to maintain the chelating agent in a deprotonated state. Chelating Ca2+ improves yield while isolating trichomes from large volumes of biomass. The chelating agent softens attachment of the lamella between the trichome head and the stalk, facilitating easy and consistent removal of the trichome stalk from leaves, bracts, calyxes, cones, strobili or other plant matter. Agitation of the chilled solution facilitates exposure of the lamella to the chelating agent and softening of the lamella.

[0064] A reducing agent may be added to the chilled solution to decrease the oxidation state of the solution. Decreasing the oxidation state of the solution may mitigate degradation of phytocannabinoids, terpenoids, isopropanoids and other compounds in the trichomes due to from oxidation via UV light or air. Degradation may result in conversion of CBD to cannabinodiol ("**CBND**"), and conversion of other phytocannabinoid, terpenoids, phenylpropanoids or other compounds into degradation products. Mitigating degradation may increase the shelf life of the trichomes. The reducing agent may be added to the processing solvent at a concentration sufficient to mitigate oxidation of the phytocannabinoids by the solution. The reducing agent may be added to the dried trichomes, either before or after pelletizing by pouring a solution of the reducing agent through the dried trichomes.

[0065] One reducing agent that may be used is L-cysteine and the corresponding L-cystine, which are non-essential amino acids that can act as reducing agents. Disulphide L-cystine may be formed through the conversion of the amino acid methionine. L-cysteine hydrochloride is used in the baking industry as dough conditioner by breaking disulfide bonds of gluten to lowers the viscosity of dough. Other suitable reducing agents may be applied (e.g. L-cystine (disulphide – not L-cysteine) sorbic acid, ascorbic acid, fumaric acid, sodium bisulphite, sodium metabisulphite, urea, glutatione, etc.).

[0066] Grinding media may be added to the solution with the biomass to facilitate breaking up the biomass during agitation through shear forces that break the trichome heads from the trichome stalks on an epidermal surface of a leaves, bracts, calyxes, cones, strobili or other plant matter. Agitation may be at a lower agitation temperature for agitation, which may facilitate avoiding disrupting the trichome head structure. If the trichome head structure is disrupted, phytocannabinoids and other chemicals may be lost into the extraction system. Any suitable grinding media may be used (e.g. sharp plastic, walnut shells, etc.). Ice bubble hash uses sharp ice to fracture the trichome heads, but the duration of the effect would be limited to the time the ice remains sharp and does not melt to a rounded shape.

[0067] Grinding media may also include dry ice to freeze the biomass and facilitate separating the trichomes from the structural plant matter. Liquid nitrogen may also be added to the biomass prior to or during grinding to facilitate separating the trichomes from the structural plant matter.

[0068] A large agitation device may be applied to the solution for agitation (e.g. a cement mixer, a continuous tunnel washer ("**CTW**"), mixer machine, mixer agitator, mixing chamber/chamber mixer, animal feed mixer, propeller agitator, chamber kneader mixer, viscous liquid mixer, blade mixer, kneading machine, solid liquid mixer, paddle mixer, high shear liquid mixer, blending tank, etc.) to sheer the trichomes from bracts, leaves, calyxes, cones or strobili of the biomass in the cold buffer. Chilled trichomes are brittle at near freezing temperatures and agitation with

grinding media facilitates breaking of the head cells from the stalk cells and releasing the head cells into the solvent. The chilled and chelated biomass will come into multiple contacts with the grinding media during agitation to sheer the trichome heads off the leaves, calyxes and bracts over a continuous wash period. The agitation device includes a large vessel that rotates or otherwise creates turbulent flow (e.g. static mixers, inline high sheer rotor stator homogenizers, shakers, vortex mixers, water mixers, homogenizers, ultra-high pressure homogenizers, liquid jet tank mixing nozzles, venturi tube fluid jets, and educator systems, colloid mills, impellers with paddles, magnetic drive sealless agitators, etc.), to maintain agitation of the grinding media against the, breaking off cooled and brittle trichome heads to be released into the solution. The ultra-high pressure homogenizer creates emulsions regardless of flow thanks to scalability of the acceleration and ultrasonic cavitation through controlled turbulent flow.

[0069] Chamber and continuous flow processing may each be applied, with duration and strength of agitation being parameters to optimize in any given application to adjust exposure to the chelation agent. A continuous flow agitation system may be optimized for sufficient agitation from the front of the system to the end of the system, or may require a second pass.

[0070] Following chelation and agitation, a coarse primary filter with a pore size larger than the trichomes, (e.g. about 250 µm, etc.) may be applied to the chilled solution and biomass to retain the biomass while allowing the trichomes to pass through the filter for collection. The coarse primary filter may be any suitable filter, (e.g. wire or plastic grid mesh sieve filter, etc.). The coarse primary filter may be positioned over an aperture into a trichome recovery vessel from the agitator, or into a solvent recovery vessel from the agitator, to allow collection of the trichome rich solution in a collection reservoir while holding back the biomass. The grinding media may be selected with a size larger than the pore size to facilitate retention of the grinding media with the biomass for removal or collection. The trichomes and the fluid phase may be recovered for further processing.

[0071] Following coarse primary filtration, fine secondary filter with a pore size smaller than the trichomes (e.g. about 25 µm, etc.) may be applied to the trichomes and the solution to retain the trichomes while allowing the solvent and very small particles of biomass to pass through for recycling. A high pressure, low volume spray of solvent may be applied to the fine secondary filter to sweep any trichomes or other material from the fine secondary filter for collection. The fine secondary filter may be any suitable filter, (e.g. wire or plastic grid mesh sieve filter, etc.). The fine secondary filter may be positioned over an aperture into the solvent recovery vessel from the agitator or from the trichome recovery vessel, to allow collection of the solution in a collection reservoir while holding back the trichomes for recovery.

[0072] A trichome paste mass may be prepared by washing the trichomes with chilled solvent and reducing agent, the solvent lacking the chelating agent, to remove any chelating agent from the trichome mass. The trichomes are sticky, and automation of the method with minimal human touching may facilitate recovery of the trichomes.

[0073] After rinsing with solvent and reducing agent, the wet trichome mass may be dried by centrifuging or any suitable method (e.g. multidisc roller system, belt press, piston press, inline filters, auger screw press, gravity thickener, etc.). A dewatering centrifuge may be applied to remove as much solvent as possible from the trichome solids prior to drying. The dewatering centrifuge may be used to remove any remaining fluid, with centrifugal force pressing liquid from the trichomes prior to pelleting and drying. Dewatering may also be carried out through application of a vacuum filter, filter press, sludge screw press; screw press separator, drying bed, solid liquid separator; slurry separator, dewatering equipment or dewatering screen.

[0074] The sticky trichomes may adhere to the walls of the centrifuge. To facilitate recovery of the trichomes, a mesh may be added to the centrifuge walls mitigate adhesion of the trichomes to the centrifuge walls. The trichome mass may be peeled from the mesh.

[0075] After dewatering, the trichome mass may be compressed into pellets by a pelletizing machine. The moisture content may be tested before addition to a

pelleting machine. Trichome mass with a high moisture content was may be separated from low moisture content trichome mass. The mass may be under 15%. Mass with greater moisture content may be dried before pelleting by any suitable approach to mitigate potential loss from fungi or other pests (e.g. air drying in a low humidity environment with airflow, chamber drying at low temperature of 40 °C or less, belt drying at low temperature of 40 °C or less, etc.).

[0076] Heat produced by the running pellet machine needed to be reduced to avoid burning off the phytocannabinoids. Pelletizing may be accomplished by plasticizing the trichome mass with pressure, at a temperature sufficiently high to facilitate plasticizing the trichome mass but sufficiently low to avoid charring the trichome mass. The trichome mass may be plasticized under pressure to binds the particles together and mold the pellets. The pellets are molded by being pressed through pellet dies of the pellet machines, and then cut off by a cutter to the desired length. Pelletizing may be completed without a binding agent to improve the pellet strength or durability. Once extruded, the pellets may be dried.

[0077] Drying the pellets may be completed by placing the pellets on a wire mesh of a tray drying shelf in a thin layer. The tray drying shelf may have a tier with an open wire design for air drying from above and from underneath with active air movement. The air movement may be from a small fan. The trays may be located in a structure may slid in and out of the structure for access to recover dried pellets and add trays of wet pellets.

[0078] After drying, the pellets may be at a RH of about 15%, and may be sufficiently dry to be stable during long term storage well after harvest. Oxidative damage may be mitigated by removing oxygen from a container in which the pellets are stored and replace the oxygen with an inert gas (e.g. N_2, Ar, etc.) to improve shelf life of the pellets. Nitrogen packaging or modified atmosphere packaging may be applied. The presence of nitrogen, argon or other gases may mitigate propagation of molds, yeast and aerobic bacteria on the trichome pellets. Replacing oxygen with nitrogen also reduces oxidation of phytocannabinoid, terpenoids, isopropanoids and other compounds. For long-term dry storage, the pellets may be preserved in Mylar

bags filled with nitrogen, and then sealed inside plastic tubs to prevent degradation and pathogen attack.

[0079] The system may combine functionality of the trichome recovery vessel and the dewatering unit are combined in one recovery and dewatering unit. After application of the coarse filter to the trichomes and the solvent, the trichomes may be dewatered in the recovery and dewatering unit. The solvent may be provided to the solvent recovery vessel for reuse or disposal. The dewatered trichomes may be pelletized.

[0080] Several aspects of the above procedures may be optimized for different cultivars or other varieties of *C. sativa*, H. Lupulus, or other plants. The solution temperature, rotation speed, run times, volume of grinding media, recycling of solvent, etc. may be optimized. To capture remaining trichomes from the retained plant matter, a wash of the plant matter with addition buffered solvent and chelating agent and reducing agent may be applied, and the retained plant matter then agitated and passed through the system again to increase yield of trichomes.

[0081] Fig. 1 shows a schematic of a trichome isolation system 10. The trichome isolation system 10 includes an agitation unit 20 for receiving a biomass solution 12, the biomass solution including untreated biomass (e.g. the untreated biomass 311 of Fig. 6) and solvent (e.g. solvent 349, 449, 549, 649). The untreated biomass includes trichomes bound to structural plant material. Treated biomass 22 is isolated from the biomass solution 12 in the agitation unit 20, resulting in isolated trichomes 32 and treated solvent 42. The agitation unit 20 is in fluid communication with a trichome recovery vessel 30 for receiving the isolated trichomes 32 and the treated solvent 42 in the trichome recovery vessel 30. The trichome recovery vessel 30 is in fluid communication with a solvent recovery vessel 40 for receiving the treated solvent 42 in the solvent recovery vessel 40 for recycling or disposal, and isolating the isolated trichomes 32 in the trichome recovery vessel 30. A dewatering unit 50 is in fluid communication with the trichome recovery vessel 30 for receiving the isolated trichomes 32 and dewatering the isolated trichomes 32 into dewatered

trichomes 52. A pelletizing unit 60 is available for pelletize the dewatered trichomes 52 into pellets 62.

[0082] The biomass solution 12 is added to the agitation unit 20 where the biomass solution 12 is exposed to a chelating agent for breaking down lamella between cells in the biomass included in the biomass solution 12, resulting in the treated biomass 22. The biomass solution 12 may be left to soak in the chelating agent for a period of time prior to agitation, and may be soaked at a selecting chilling temperature (e.g. between 2 °C and 6 °C, 2 °C, 3°C, 4°C, 5 °C, etc.). Once the biomass solution 12 has soaked at the chilling temperature for a selected period of time, the biomass solution 12 may be agitated in the agitation unit 20. The biomass solution 12 may be agitated in the agitation unit 20 for a selected period of time, and may be agitated at a selected agitation temperature (e.g. between 2 °C and 6 °C, 2 °C, 3°C, 4°C, 5 °C, etc.). The agitation temperature and the soaking temperature may be the same temperature or may be different temperatures. Following a sufficient amount of time and agitation at the selected agitation temperature, the biomass solution 12 is passed through a coarse filter 24. The coarse filter 24 may be located in a flow path 26 between the agitation unit 20 and the trichome recovery vessel 30.

[0083] As the biomass solution 12 passes through the coarse filter 24, the treated biomass 22, and any grinding material that is coarser than the filter size of the coarse filter 24, are retained in the agitation unit 20. The treated biomass 22 may be recovered from the agitation unit 20 for disposal or for application to a second cycle through the system 10. The isolated trichomes 32 and the treated solvent 42 pass through the coarse filter 24 and the flow path 26 into the trichome recovery vessel 30. The isolated trichomes 32 and the treated solvent 42 in the trichome recovery vessel 30 are passed through a fine filter 34. The fine filter 34 may be located in a flow path 36 between the trichome recovery vessel 30 and the solvent recovery vessel 40.

[0084] As the isolated trichomes 32 and the treated solvent 42 pass through the fine filter 34, the isolated trichomes 32 and any other material that is coarser than the filter size of the fine filter 34 are retained in the trichome recovery vessel 30. The

treated solvent 42 passes through the fine filter 34 and the second flow path 36 to the solvent recovery vessel 40 for disposal, for recovery and reuse in the system 10, or for further processing to remove terpenophenolics or other compounds that remain in the treated solvent 42.

[0085] The isolated trichomes 32 may be recovered from the trichome recovery vessel 30 and provided to the dewatering unit 50. The dewatering unit 50 may be any suitable dewatering unit (e.g. dewatering centrifuge, vacuum filter, filter press, sludge screw press; screw press separator, drying bed, solid liquid separator; slurry separator, dewatering equipment, dewatering screen, etc.). The dewatering unit 50 may be applied to the isolated trichomes 32, resulting in dewatered trichomes 52. The dewatered trichomes 52 may be recovered from the dewatering unit 50 for storage or further processing.

[0086] Further processing of the dewatered trichomes 52 may include pelletizing the dewatered trichomes 52. The dewatered trichomes 52 may be provided to the pelletizing unit 60 for preparing pellets 62 of trichomes for storage and extraction.

[0087] Fig. 2 shows a schematic of a trichome isolation system 110. The trichome isolation system 110 includes the agitation unit 120 for receiving the biomass solution 112, the biomass solution including untreated biomass and solvent. The untreated biomass includes trichomes bound to structural plant material. The treated biomass 122 is isolated from the biomass solution 112 in the agitation unit 120, resulting in the isolated trichomes 132 and the treated solvent 142. The agitation unit 120 is in fluid communication with a recovery and dewatering vessel 170 for receiving the isolated trichomes 132 and the treated solvent 142 in the recovery and dewatering vessel 170, and dewatering the isolated trichomes 132 into the dewatered trichomes 152. The recovery and dewatering vessel 170 is in fluid communication with the solvent recovery vessel 140 for receiving the treated solvent 142 in the solvent recovery vessel 140 for recycling or disposal, and isolating the isolated trichomes 132 in the recovery and dewatering vessel 170. The pelletizing unit 160 is available for pelletize the dewatered trichomes 152 into pellets 162.

[0088] The biomass solution 112 is added to the agitation unit 120 where the biomass solution 112 is exposed to the chelating agent for breaking down lamella between cells in the biomass included in the biomass solution 112, resulting in the treated biomass 122. The biomass solution 112 may be left to soak in the chelating agent for a period of time prior to agitation, and may be soaked at a selecting chilling temperature (e.g. between 2 °C and 6 °C, 2 °C, 3°C, 4°C, 5 °C, etc.). Once the biomass solution 112 has soaked at the chilling temperature for a selected period of time, the biomass solution 112 may be agitated in the agitation unit 120. The biomass solution 112 may be agitated in the agitation unit 120 for a selected period of time, and may be agitated at a selected agitation temperature (e.g. between 2 °C and 6 °C, 2 °C, 3°C, 4°C, 5 °C, etc.). The agitation temperature and the soaking temperature may be the same temperature or may be different temperatures. Following a sufficient amount of time and agitation at the selected agitation temperature, the biomass solution 112 is passed through the coarse filter 124. The coarse filter 124 may be located in the flow path 126 between the agitation unit 120 and the recovery and dewatering vessel 170.

[0089] As the biomass solution 112 passes through the coarse filter 124, the treated biomass 122, and any grinding material that is coarser than the filter size of the coarse filter 124, are retained in the agitation unit 120. The treated biomass 122 may be recovered from the agitation unit 120 for disposal or for application to a second cycle through the system 110. The isolated trichomes 132 and the treated solvent 142 pass through the coarse filter 124 and the flow path 126 into the recovery and dewatering vessel 170. The isolated trichomes 132 and the treated solvent 142 in the recovery and dewatering vessel 170 are passed through the fine filter 134. The fine filter 134 may be located in the flow path 176 between the recovery and dewatering vessel 170 and the solvent recovery vessel 140.

[0090] As the isolated trichomes 132 and the treated solvent 142 pass through the fine filter 134, the isolated trichomes 132 and any other material that is coarser than the filter size of the fine filter 134 are retained in the recovery and dewatering vessel 170. The treated solvent 142 passes through the fine filter 134 and the

second flow path 176 to the solvent recovery vessel 140 for disposal, for recovery and reuse in the system 110, or for further processing to remove terpenophenolics or other compounds that remain in the treated solvent 142.

[0091] The isolated trichomes 132 may be recovered from the recovery and dewatering vessel 170 and provided to the recovery and dewatering vessel 170. The recovery and dewatering vessel 170 may include any suitable dewatering mechanism (e.g. dewatering centrifuge, vacuum filter, filter press, sludge screw press; screw press separator, drying bed, solid liquid separator; slurry separator, dewatering equipment, dewatering screen, etc.). The recovery and dewatering vessel 170 may be applied to the isolated trichomes 132, resulting in the dewatered trichomes 152. The dewatered trichomes 152 may be recovered from the recovery and dewatering vessel 170 for storage or further processing.

[0092] Further processing of the dewatered trichomes 152 may include pelletizing the dewatered trichomes 152. The dewatered trichomes 152 may be provided to the pelletizing unit 160 for preparing pellets 162 of trichomes for storage and extraction.

[0093] Fig. 3 shows a schematic of a trichome isolation system 210. The trichome isolation system 210 includes a debucker 202 for receiving unprocessed harvest material 201 and debucking the unprocessed harvest material 201 by removing stems, resulting in untreated biomass 211. The untreated biomass 211 falls into a hopper 203. The hopper 203 directs the untreated biomass 211 to a conveyor belt 204. The untreated biomass 211 is passed along the conveyor belt 204 and combined with solvent 213 to provide the biomass solution 212. The biomass solution is provided to the agitation unit 220 for receiving the biomass solution 212. A portion of the treated biomass 222 is isolated from the biomass solution 212 in the agitation unit 220, resulting in the isolated trichomes 232 and the treated solvent 242. The agitation unit 220 is in fluid communication with a jet pump 280 for receiving the biomass solution. The jet pump 280 is in fluid communication with a static mixer 270 and a trommel 278. The trommel 278 is in communication with the trichome recovery vessel 230 for receiving the isolated trichomes 232 and

the treated solvent 242 in the trichome recovery vessel 230 while retaining the treated biomass 222 in the trommel 278. The trichome recovery vessel 230 is in fluid communication with the solvent recovery vessel 240 for receiving the treated solvent 242 in the solvent recovery vessel 240 and isolating the isolated trichomes 232 in the trichome recovery vessel 230. The dewatering unit 250 is in fluid communication with the trichome recovery vessel 230 for receiving the isolated trichomes 232 and dewatering the isolated trichomes 232 into the dewatered trichomes 252. The pelletizing unit 260 is available for pelletize the dewatered trichomes 252 into pellets 262.

[0094] The untreated biomass 211 is combined with the solvent 213 to provide the biomass solution 212 prior to or upon providing the biomass solution 212 to the agitation unit 220. The agitation unit includes a body 221 and paddles 223 for rotary agitation of the biomass solution 212. In the body 221, prior to and during agitation with the paddles 223, the biomass solution 212 is exposed to the chelating agent for breaking down lamella between cells in the untreated biomass 211, resulting in the treated biomass 222. The biomass solution 212 may be left to soak in the chelating agent for a period of time prior to agitation with the paddles 223, and may be soaked at a selecting chilling temperature (e.g. between 2 °C and 6 °C, 2 °C, 3°C, 4°C, 5 °C, etc.). Once the biomass solution 212 has soaked at the chilling temperature for a selected period of time, the biomass solution 212 may be agitated in the agitation unit 220 by the paddles 223. The biomass solution 212 may be agitated in the agitation unit 220 for a selected period of time, and may be agitated at a selected agitation temperature (e.g. between 2 °C and 6 °C, 2 °C, 3°C, 4°C, 5 °C, etc.). The agitation temperature and the soaking temperature may be the same temperature or may be different temperatures.

[0095] Fig. 4 shows a schematic of the jet pump 280. After agitation in the agitation unit 220, the biomass solution 212 flows through to the jet pump 280. The jet pump 280 includes a venturi nozzle 282, and a diffuser 284. The venturi nozzle 282 is separated from the diffuser 284 by a venturi gap 283. A pressurizing unit 228 (Fig. 3) provides the solvent 213 to a jet input 229. The jet input 229 is in fluid

communication with the venturi nozzle 282 for providing the solvent 213 at pressure to the venturi nozzle 282. The venturi nozzle 282 sprays the solvent 213 at pressure across the venturi gap 283 and into the diffuser 284. As the solvent 213 crosses the venturi gap 283, a pressure drop is created at the venturi gap 283, drawing the biomass solution 212 into the venturi gap 283 and into the diffuser 284. From the diffuser 284, the biomass solution 212 flows into a flow path 225 for provision to the static mixer 270.

[0096] Returning to Fig. 3, the biomass solution 212 passes from the jet pump 280 to the static mixer 270. The static mixer 270 includes a turbulent flow body 274 with a turbulent flow cavity 271 defined within the turbulent flow body 274. A series of turbulent flow baffles 273 are located within the turbulent flow cavity 271 for imparting turbulent flow to the biomass solution 212 as the biomass solution 212 flows through the turbulent flow body 274, providing additional agitation to the biomass solution 212. The biomass solution 212 flows from the turbulent flow body 274 to the laminar flow body 276.

[0097] The laminar flow body 276 includes a laminar flow cavity 275 defined within the laminar flow body 276. A series of laminar flow baffles 277 are located within the laminar flow cavity 275 for imparting laminar flow to the biomass solution 212 as the biomass solution 212 flows through the laminar flow body 276, providing additional agitation to the biomass solution 212. The biomass solution 212 flows from the laminar flow body 276 to the trommel 278.

[0098] The trommel 278 includes a trommel cage 279 positioned at an angle to allow recovery of any particles that have a greater cross-sectional area in their smallest dimension than gaps in the trommel cage 279 (e.g. about 0.5 mm, 1.0 mm, 1.5 mm, 2.0 mm, 2.5 mm, etc.). The isolated trichomes 232, the treated solution solvent 242 and a portion of the treated biomass 222 (with a particle size smaller than the gaps in the trommel cage 279) pass through the trommel cage 279 and into a flow path 227 providing fluid communication between the trommel 278 and the trichomes recovery vessel 230. A portion of the treated biomass 222 larger than the gaps in the trommel cage 279 are also recovered at a lower end of the trommel cage

279. The treated biomass 222 may be discarded, compressed into biomass pellets or otherwise processed, or reintroduced into the agitation unit 220 for secondary processing.

[0099] In the trichome recovery vessel 230, the biomass solution 212 passes through the coarse filter 224. As the isolated trichomes 232 and the treated solution 242 pass through the coarse filter 224, the treated biomass 222, and any grinding material that is coarser than the filter size of the coarse filter 224, are retained and segregated, within the trichome recovery vessel 230, from the isolated trichomes 232 and the treated solvent 242. The treated biomass 222 may be recovered from the trichome recovery vessel 230 for disposal or for application to a second cycle through the system 210, and may be combined with the treated biomass 222 recovered from the lower end of the trommel cage 279.

[00100] The isolated trichomes 232 and the treated solvent 242 pass through the coarse filter 224 and to the fine filter 234. The isolated trichomes 232 are retained by the fine filter 234 and may be recovered from the trichome recovery vessel 230. The treated solvent 242 in the trichome recovery vessel 230 passes through the fine filter 234 and to the solvent recovery vessel 240. In the solvent recovery vessel, the treated solvent 242 may separate into an organic phase 241 and the recovered solvent 243. The recovered solvent 243 may be disposed of, reused in the system 210, or further processed. The organic phase 241 may include terpenophenolics or other compounds that remained in the treated solvent 242. The terpenophenolics, terpenoids and other organic compounds with a lower density than water and found in the organic phase 241, may be recovered from the solvent recovery vessel 240.

[00101] The isolated trichomes 232 may be recovered from the trichome recovery vessel 230 and provided to the dewatering unit 250. The dewatering unit 250 may be any suitable dewatering unit (e.g. a multidisc roller system, a belt press, a piston press, inline filters, an auger screw press, a gravity thickener, a dewatering centrifuge, a vacuum filter, a filter press, a sludge screw press, a screw press separator, a drying bed, a solid liquid separator, a slurry separator, dewatering

equipment, a dewatering screen, etc.). In this case, the dewatering unit 250 includes a dewatering centrifuge 254. The dewatering centrifuge 254 may be applied to the isolated trichomes 232, resulting in dewatered trichomes 252. The dewatered trichomes 252 may be recovered from the dewatering centrifuge 254 for storage or further processing.

[00102] Further processing of the dewatered trichomes 252 may include pelletizing the dewatered trichomes 252. The dewatered trichomes 252 may be provided to the pelletizing unit 260 for preparing pellets 262 of trichomes for storage and extraction.

[00103] Figs. 5 and 6 show a schematic of a trichome isolation system 310. The system 310 includes a cryogenic hammer mill 314 in communication with a preliminary filter set in a pre-treatment sifter shaker 363 through a transfer path 315 (e.g. a conveyor belt, a hopper, etc.). The cryogenic hammer mill 314 may be operated at a temperature of -80 °C, subject to heating as a result of friction, and the operating temperature may be between -20 °C and -80 °C. The pre-treatment sifter shaker 363 includes a pre-treatment coarse filter 364 and a pre-treatment fine filter 366. The pre-treatment sifter shaker 363 is in communication with a disposal unit 339 through a disposal transfer path 317. The pre-treatment sifter shaker 363 includes a selection zone 365 between the pre-treatment coarse filter 364 and the pre-treatment fine filter 366, and a recovery zone 367 downstream of the pre-treatment fine filter 366. The selection zone 365 is in communication with a dry-sifted biomass storage 345 that is in turn in communication with a hopper 347. The hopper 347 is in communication with the agitation unit 320 through an input transfer path 305. The recovery zone 367 is in communication through a recovery transfer path 319 with the dewatering unit 350.

[00104] The agitation unit 320 is in fluid communication with a chelating agent vessel 351 through a chelating agent flowpath 331. The agitation unit 320 is in fluid communication with a base vessel 353 through a base flowpath 333. The agitation unit 320 is in fluid communication with a water vessel 355 through a water flowpath 335. The agitation unit 320 is in fluid communication with a shaker sifter 346 through

the flow path 326. The shaker sifter 346 includes the coarse filter 324, the trichome recovery vessel 330, the fine filter 334 and the solvent recovery vessel 340. The shaker sifter 346 is in communication with the cryogenic hammer mill 314 upstream of the fine filter 324. The trichome recovery vessel 330 portion of the shaker sifter 346 is in communication with the dewatering unit 350. The solvent recovery vessel 340 portion of the shaker sifter 346 is in communication with the with the disposal unit 339.

[00105] The pre-treatment coarse filter 364 and the pre-treatment fine filter 366 may be selected to have a narrower window of particle sizes that make up the dry-sifted biomass 307 than is the case for the coarse filter 324 and the fine filter 334. For example, the pre-treatment coarse filter 364 may have a pore size of 250 µm, the pre-treatment fine filter 366 may have a pore size of 25 µm, the coarse filter 324 may have a pore size of 150 µm and the fine filter 334 may have a pore size of 75 µm.

[00106] The unprocessed harvest material 301 is run through the cryogenic hammer mill 314, providing ground biomass 309. The ground biomass 309 is conveyed to the sifter shaker 363. The ground biomass 309 is passed through the pre-treatment coarse filter 364. The treated biomass 322 retained by the pre-treatment coarse filter 364 is conveyed to the disposal unit 339. Sifted biomass 307 that passes through the pre-treatment coarse filter 364 to the selection zone 365, and that is retained by the pre-treatment fine filter 366, is conveyed to the dry-sifted biomass storage 345, dropped into the hopper 347 and conveyed to the agitation unit 320. The isolated trichomes 332 that pass through the pre-treatment fine filter 366 are conveyed to the pelletizing unit 360 for compressing into the pellets 362.

[00107] The agitation unit 320 receives the dry-sifted biomass 307. The paddles 323 mix the dry-sifted biomass 307 with the solvent 349 to provide the biomass solution 312. The biomass solution 312 is exposed to the chelating agent for breaking down lamella between cells in the biomass included in the biomass solution 312, resulting in the treated biomass 322. The biomass solution 312 may be mixed with chelating agent 361 from the chelating agent vessel 351. The biomass solution 312 may be mixed with base 368 from the base vessel 353 for raising the pH

of the biomass solution 312. The biomass solution 312 may be mixed with water 369 from the water vessel 355. The biomass solution 312 may be mixed with the chelating agent 361, the base 368 and water 369 sequentially or simultaneously. The agitation unit 320 may for example contain 250 L of the biomass solution 312, 100 L of 50 mM EDTA as the chelating agent 361, 100 L of the water 369 and 50 L of 10% NaOH as the base 368 to provide 500 L of slurry.

[00108] The biomass solution 312 may be left to soak in the chelating agent for a period of time prior to agitation, and may be soaked at a selecting chilling temperature (e.g. between 2 °C and 6 °C, 2 °C, 3°C, 4°C, 5 °C, etc.). Once the biomass solution 312 has soaked at the chilling temperature for a selected period of time, the biomass solution 312 may be agitated in the agitation unit 320. The biomass solution 312 may be agitated in the agitation unit 320 for a selected period of time, and may be agitated at a selected agitation temperature (e.g. between 2 °C and 6 °C, 2 °C, 3°C, 4°C, 5 °C, etc.). The agitation temperature and the soaking temperature may be the same temperature or may be different temperatures. Following a sufficient amount of time and agitation at the selected agitation temperature, the biomass solution 312 is passed through the flow path 326 and into the sifter shaker 346.

[00109] As the biomass solution 312 passes through the coarse filter 324, the treated biomass 322, and any grinding material that is coarser than the filter size of the coarse filter 324, are retained in the sifter shaker 346. The treated biomass 322 may be recovered from the sifter shaker 346 to a disposal unit 339 or to the mill 314 for application to a second cycle through the system 310. The isolated trichomes 332 and the treated solvent 342 pass through the coarse filter 324 and the flow path 326 into a portion of the sifter shaker 346 that defines the trichome recovery vessel 330. The isolated trichomes 332 and the treated solvent 342 in the trichome recovery vessel 330 are passed through the fine filter 334, where the isolated trichomes 332 and any other material that is coarser than the filter size of the fine filter 334 are retained in the trichome recovery vessel 330 portion of the sifter shaker 346. The treated solvent 342 passes through the fine filter 334 to the solvent recovery vessel

340 for disposal in the disposal unit 339, for recovery and reuse in the system 310, or for further processing to remove terpenophenolics or other compounds that remain in the treated solvent 342.

[00110] The isolated trichomes 332 may be recovered from the trichome recovery vessel 330 and provided to the dewatering unit 350. The dewatering unit 350 may include any suitable dewatering mechanism (e.g. dewatering centrifuge, vacuum filter, filter press, sludge screw press; screw press separator, drying bed, solid liquid separator; slurry separator, dewatering equipment, dewatering screen, etc.). The dewatering unit 350 may be applied to the isolated trichomes 332, resulting in the dewatered trichomes 352. The dewatered trichomes 352 may be recovered from the dewatering unit 350 for storage or further processing.

[00111] Further processing of the dewatered trichomes 352 may include pelletizing the dewatered trichomes 352. The dewatered trichomes 352 may be provided to the pelletizing unit 360 for preparing pellets 362 of trichomes for storage and extraction.

[00112] Figs. 7 to 14 show a schematic of a trichome isolation system 410. The agitation unit 420 is in fluid communication with a chelating agent vessel 451 through a chelating agent flowpath 431. The agitation unit 420 is in fluid communication with a base vessel 453 through a base flowpath 433. The agitation unit 420 is in fluid communication with a water vessel 455 through a water flowpath 435. The agitation unit 420 empties the biomass solution 412 through the flow path 426 for passing through a coarse filter, being retained by a fine filter, dewatered and pelleted (not shown; see coarse filter 324, fine filter 334, dewatering unit 350 and pelletizer 360 of Fig. 3).

[00113] The agitation unit 420 receives the untreated biomass 411. The paddles 423 mix the dry-sifted biomass 411 with the solvent 449 to provide the biomass solution 412. The biomass solution 412 is exposed to the chelating agent for breaking down lamella between cells in the biomass included in the biomass solution 412, resulting in the treated biomass (not shown; see treated biomass 22 in Fig. 1, treated biomass 122 in Fig. 2, treated biomass 222 in Fig. 3, treated biomass

522 in Fig. 13 and treated biomass 622 in Fig. 14). The biomass solution 412 may be mixed with chelating agent 461 from the chelating agent vessel 451. The biomass solution 412 may be mixed with base 468 from the base vessel 453 for raising the pH of the biomass solution 412. The biomass solution 412 may be mixed with water 469 from the water vessel 455. The biomass solution 412 may be mixed with surfactant 459 from the surfactant vessel 457. The biomass solution 412 may be mixed with the chelating agent 461, the base 468, the water 469 and the surfactant 459 simultaneously (Fig. 8) or sequentially (Figs. 9 to 12). The mixing tank 420 may for example contain 250 L of the biomass solution 412, 100 L of 50 mM EDTA as the chelating agent 461, 100 L of the water 469 and 50 L of 10% NaOH as the base 468, and SDS as the surfactant 459 provided to a concentration selected with reference to the untreated biomass 411, the surfactant 459 offset from the water 469 to provide 500 L of slurry. The detergent may facilitate the digestion of the treated biomass in the biomass solution 412.

[00114] The biomass solution 412 may be left to soak in the chelating agent for a period of time prior to agitation, and may be soaked at a selecting chilling temperature (e.g. between 2 °C and 6 °C, 2 °C, 3°C, 4°C, 5 °C, etc.). Once the biomass solution 412 has soaked at the chilling temperature for a selected period of time, the biomass solution 412 may be agitated in the agitation unit 420. The biomass solution 412 may be agitated in the agitation unit 420 for a selected period of time, and may be agitated at a selected agitation temperature (e.g. between 2 °C and 6 °C, 2 °C, 3°C, 4°C, 5 °C, etc.). The agitation temperature and the soaking temperature may be the same temperature or may be different temperatures. Following a sufficient amount of time and agitation at the selected agitation temperature, the biomass solution 412 is passed through the flow path 426.

[00115] Fig. 13 show a schematic of a trichome isolation system 510. The agitation unit 520 is in fluid communication with a chelating agent vessel 551 through a chelating agent flowpath 531. The agitation unit 520 is in fluid communication with a base vessel 553 through a base flowpath 533. The agitation unit 520 is in fluid communication with a water vessel 555 through a water flowpath 535. The agitation

unit 520 is in fluid communication with a shaker sifter 546 through the flow path 526. The shaker sifter 546 includes the coarse filter 524, the trichome recovery vessel 530, the fine filter 534 and the solvent recovery vessel 540. The shaker sifter 546 is in communication a mill or other input point for the untreated biomass 511 upstream of the fine filter 524. The trichome recovery vessel 530 portion of the shaker sifter 546 is in communication with a dewatering unit (not shown; see dewatering unit 50 of Fig. 1, dewatering unit 350 of Figs. 5 and 6, etc.). The solvent recovery vessel 540 portion of the shaker sifter 546 is in communication with the a disposal unit (not shown).

[00116] The agitation unit 520 receives the untreated biomass 511. The paddles 523 mix the untreated biomass 511 with the solvent 549 to provide the biomass solution 512. The biomass solution 512 is exposed to the chelating agent for breaking down lamella between cells in the biomass included in the biomass solution 512, resulting in the treated biomass 522. The biomass solution 512 may be mixed with chelating agent 561 from the chelating agent vessel 551. The biomass solution 512 may be mixed with base 568 from the base vessel 553 for raising the pH of the biomass solution 512. The biomass solution 512 may be mixed with water 569 from the water vessel 555. The biomass solution 512 may be mixed with surfactant 559 from the surfactant vessel 557. The biomass solution 512 may be mixed with the chelating agent 561, the base 568, the water 569 and the surfactant sequentially or simultaneously. The mixing tank 520 may for example contain 250 L of the biomass solution 512, 100 L of 50 mM EDTA as the chelating agent 561, 100 L of the water 569 and 50 L of 10% NaOH as the base 568, and SDS provided to a concentration selected with reference to the untreated biomass 511, the SDS offset from the water 569, to provide 500 L of slurry. The detergent may facilitate the digestion of the treated biomass 522 in the biomass solution 512.

[00117] The biomass solution 512 may be left to soak in the chelating agent for a period of time prior to agitation, and may be soaked at a selecting chilling temperature (e.g. between 2 °C and 6 °C, 2 °C, 3°C, 4°C, 5 °C, etc.). Once the biomass solution 512 has soaked at the chilling temperature for a selected period of

time, the biomass solution 512 may be agitated in the agitation unit 520. The biomass solution 512 may be agitated in the agitation unit 520 for a selected period of time, and may be agitated at a selected agitation temperature (e.g. between 2 °C and 6 °C, 2 °C, 3°C, 4°C, 5 °C, etc.). The agitation temperature and the soaking temperature may be the same temperature or may be different temperatures. Following a sufficient amount of time and agitation at the selected agitation temperature, the biomass solution 512 is passed through the flow path 526 and into the sifter shaker 546.

[00118] The system 510 includes a venturi 580 downstream of the agitation unit 520 and upstream of the sifter shaker 546 for separating the isolated trichomes 532 from the treated biomass 522. The system 510 includes a static mixer 586 downstream of the venturi 580 and upstream of the of the sifter shaker 546 for separating the isolated trichomes 532 from the treated biomass 522. The system 510 includes a turbulent bash tube 588 downstream of the static mixer 586 and upstream of the sifter shaker 546 for separating the isolated trichomes 532 from the treated biomass 522.

[00119] As the biomass solution 512 passes through the coarse filter 524, the treated biomass 522, and any grinding material that is coarser than the filter size of the coarse filter 524, are retained in the sifter shaker 546. The treated biomass 522 may be recovered from the sifter shaker 546 for disposal or milled for application to a second cycle through the system 510. The isolated trichomes 532 and the treated solvent 542 pass through the coarse filter 524 and the flow path 526 into a portion of the sifter shaker 546 that defines the trichome recovery vessel 530. The isolated trichomes 532 and the treated solvent 542 in the trichome recovery vessel 530 are passed through the fine filter 534, where the isolated trichomes 532 and any other material that is coarser than the filter size of the fine filter 534 are retained in the trichome recovery vessel 530 portion of the sifter shaker 546. The treated solvent 542 passes through the fine filter 534 to the solvent recovery vessel 540 for disposal, for recovery and reuse in the system 510, or for further processing to remove terpenophenolics or other compounds that remain in the treated solvent 542.

[00120] The isolated trichomes 532 may be recovered from the trichome recovery vessel 530 and provided to a dewatering unit (not shown). The dewatering unit may include any suitable dewatering mechanism (e.g. dewatering centrifuge, vacuum filter, filter press, sludge screw press; screw press separator, drying bed, solid liquid separator; slurry separator, dewatering equipment, dewatering screen, etc.).

[00121] Figs. 14 show a schematic of a trichome isolation system 610. The agitation unit 620 is in fluid communication with a chelating agent vessel 651 through a chelating agent flowpath 631. The agitation unit 620 is in fluid communication with a base vessel 653 through a base flowpath 633. The agitation unit 620 is in fluid communication with a water vessel 655 through a water flowpath 635. The agitation unit 620 is in fluid communication with a shaker sifter 646 through the flow path 626. The shaker sifter 646 includes the coarse filter 624, the trichome recovery vessel 630, the fine filter 634 and the solvent recovery vessel 640. The shaker sifter 646 is in communication a mill or other input point for the untreated biomass 611 upstream of the fine filter 624. The trichome recovery vessel 630 portion of the shaker sifter 646 is in communication with the dewatering unit 650. The solvent recovery vessel 640 portion of the shaker sifter 646 is in communication with the with a disposal unit (not shown).

[00122] The agitation unit 620 receives the untreated biomass 611. The paddles 623 mix the dry-sifted biomass 611 with the solvent 649 to provide the biomass solution 612. The biomass solution 612 is exposed to the chelating agent for breaking down lamella between cells in the biomass included in the biomass solution 612, resulting in the treated biomass 622. The biomass solution 612 may be mixed with chelating agent 661 from the chelating agent vessel 651. The biomass solution 612 may be mixed with base 668 from the base vessel 653 for raising the pH of the biomass solution 612. The biomass solution 612 may be mixed with water 669 from the water vessel 655. The biomass solution 612 may be mixed with surfactant 659 from the surfactant vessel 657. The biomass solution 612 may be mixed with the chelating agent 661, the base 668, the water 669 and the surfactant sequentially or

simultaneously. The mixing tank 620 may for example contain 250 L of the biomass solution 612, 100 L of 50 mM EDTA as the chelating agent 661, 100 L of the water 669 and 50 L of 10% NaOH as the base 668, and SDS provided to a concentration selected with reference to the untreated biomass 611, the SDS offset from the water 669, to provide 500 L of slurry. The detergent may facilitate the digestion of the treated biomass 622 in the biomass solution 612.

[00123] The biomass solution 612 may be left to soak in the chelating agent for a period of time prior to agitation, and may be soaked at a selecting chilling temperature (e.g. between 2 °C and 6 °C, 2 °C, 3°C, 4°C, 5 °C, etc.). Once the biomass solution 612 has soaked at the chilling temperature for a selected period of time, the biomass solution 612 may be agitated in the agitation unit 620. The biomass solution 612 may be agitated in the agitation unit 620 for a selected period of time, and may be agitated at a selected agitation temperature (e.g. between 2 °C and 6 °C, 2 °C, 3°C, 4°C, 5 °C, etc.). The agitation temperature and the soaking temperature may be the same temperature or may be different temperatures. Following a sufficient amount of time and agitation at the selected agitation temperature, the biomass solution 612 is passed through the flow path 626 and into the sifter shaker 646.

[00124] The system 610 includes the venturi 680 downstream of the agitation unit 620 and upstream of the sifter shaker 646 for separating the isolated trichomes 632 from the treated biomass 622. The system 610 includes the static mixer 686 downstream of the venturi 680 and upstream of the of the sifter shaker 646 for separating the isolated trichomes 632 from the treated biomass 622. The system 610 includes the turbulent bash tube 688 downstream of the static mixer 686 and upstream of the sifter shaker 646 for separating the isolated trichomes 632 from the treated biomass 622. The system 610 includes a trommel 689 downstream of the turbulent bash tube 688 and upstream of the sifter shaker 646, the trommel comprising a pore size greater than the pore size of the coarse filter 624 for filtering out treated biomass 622 upstream of the coarse filter 624. For example, the trommel 689 may have a pore size of 6 mm where the coarse filter 624 has a pore size of 250 µm.

[00125] As the biomass solution 612 passes through the coarse filter 624, the treated biomass 622, and any grinding material that is coarser than the filter size of the coarse filter 624, are retained in the sifter shaker 646. The treated biomass 622 may be recovered from the sifter shaker 646 to a disposal unit 639 or to the mill 614 for application to a second cycle through the system 610. The isolated trichomes 632 and the treated solvent 642 pass through the coarse filter 624 and the flow path 626 into a portion of the sifter shaker 646 that defines the trichome recovery vessel 630. The isolated trichomes 632 and the treated solvent 642 in the trichome recovery vessel 630 are passed through the fine filter 634, where the isolated trichomes 632 and any other material that is coarser than the filter size of the fine filter 634 are retained in the trichome recovery vessel 630 portion of the sifter shaker 646. The treated solvent 642 passes through the fine filter 634 to the solvent recovery vessel 640 for disposal in the disposal unit 639, for recovery and reuse in the system 610, or for further processing to remove terpenophenolics or other compounds that remain in the treated solvent 642.

[00126] The isolated trichomes 632 may be recovered from the trichome recovery vessel 630 and provided to the dewatering unit 650. The dewatering unit 650 may include any suitable dewatering mechanism (e.g. dewatering centrifuge, vacuum filter, filter press, sludge screw press; screw press separator, drying bed, solid liquid separator; slurry separator, dewatering equipment, dewatering screen, etc.). The dewatering unit 650 may be applied to the isolated trichomes 632, resulting in the dewatered trichomes 652. The dewatered trichomes 652 may be recovered from the dewatering unit 650 for storage or further processing.

[00127] Further processing of the dewatered trichomes 652 may include pelletizing the dewatered trichomes 652. The dewatered trichomes 652 may be provided to the pelletizing unit 660 for preparing pellets 662 of trichomes for storage and extraction.

[00128] **Measuring Phytocannabinoids in Biomass**

[00129] Trichomes were isolated by dry ice blending of biomass, sifting for biomass between 200 µm and 50 µm, addition of EDTA and NaOH, wet sifting for

biomass between 150 µm and 75 µm, rinsing and drying. This process resulted in increased concentration (% w/w) of CBD and preservation of trichome hairs and heads in the resulting filtered and rinsed isolated trichomes.

[00130] A qualitative observation based on photographs taken under microscopy is that after the treatment process, snapped junctions at the base of the trichome hairs were visible in the exhausted biomass that was separated from the isolated trichomes.

[00131] It was further observed that isolated samples of the present disclosure processed through different forms of pharmaceutical designed static mixer tube such as a 4 inch PVC tube with reversing blades, reduced impact based on roughness of the blade surfaces, easily plugged based on biomass aggregation, or reduced impact on the length of the tube or the number of blades.

[00132] Additionally, samples were processed through different forms of a bash tube after mixing but prior to wet rinsing. The bash tube includes rough or smooth baffle surface. Different numbers of baffles reduced impact based on roughness of the baffles and the number of baffles. A reduced impact on the length of the bash tube was observed based on the spacing of the baffles.

[00133] Materials

[00134] All chemicals were purchased as reagent grade and used without further purification. Dry ice was purchased from Praxair of Edmonton, Alberta and used as received. Tetrasodium EDTA was purchased from Belle Chemicals of Montreal, Québec as a powder and dissolved in warm water to a concentration of 0.5M stock solution, which was diluted to 50 mM for use in the experiments. NaOH was purchased from Belle Chemicals of Montreal, Québec as a powder and dissolved to a concentration of 10% w/v in warm water then diluted to 1%.

[00135] Methods

[00136] Buds and leaves from hemp from the approved cultivar X59 was harvested. Plant matter was weighed to 500 g and blended with 200 g dry ice in a blender to produce blended biomass. The blended biomass was dry ice sifted to isolate blended biomass measuring 50 µm to 200 µm. The isolated blended biomass

was sifted with a 200 µm filter and with a 50 µm filter. A fraction of the isolated blended plant that passed through the 200 µm filter and was retained by a 50 µm filter was transferred to a 1 L beaker and heated to 4°C. About 185 g of sifted biomass was added to the beaker and 250 mL of water was added. The water slurry was mixed with a large-faced spatula until all biomass was wet and fluid mixture could proceed at an estimated 100 rpm with a stir bar. A pre-mixed solution including 100 mL of 50 mM EDTA, 50 mL of 10% NaOH and 100 mL of water, totaling 250 mL, was added to the beaker and mixed thoroughly. The pre-mixed solution was slowly added to the wet plant slurry over a period of between 1 and 2 minutes, then incubated for 30 minutes at room temperature and ambient pressure. No additional chilling was performed.

[00137] After incubation, the mixture was wet sifted to isolate biomass measuring between 75 µm and 150 µm. The resulting isolated biomass measuring 75 µm to 150 µm was then transferred to a Büchner funnel, loaded with a 0.45 µm filter paper and the Büchner funnel was fitted to a Büchner flask. The biomass was rinsed with water to remove the solution including EDTA and NaOH, washed with water and then air dried in the funnel for 15 minutes under pressure from operating the funnel at a room temperature of approximately 21 °C to form a trichome cake. The trichome cake was then baked at 30 °C for about 16 hours or dried for multiple days on a rack with silicon sheets.

[00138] Initial chemical analysis was carried out using the Beam test, which includes adding 5% KOH dissolved in 95% food-grade ethanol dropwise to small amounts of biomass to visually and qualitatively assess amounts of CBD in the biomass. The KOH was purchased from Belle Chemicals of Montreal, Québec as a powder. The ethanol was purchased at a retail liquor store under the Everclear brand. Chemical testing was carried out by both methods on biomass at each stage of the method: untreated biomass, biomass after grinding with dry ice, biomass filtered at 50 µm and 200 µm and biomass filtered at 75 µm to 150 µm.

[00139] **Example I**

[00140] The above methods were carried out and concentrations of phytocannabinoids measured at each stage. The concentration of combined CBD and CBDA was measured at each stage of the method. Untreated biomass measured 0.24% CBD. The biomass after grinding with dry ice measured 0.55% CBD. Biomass filtered at 50 µm and 200 µm measured 0.58% CBD. Biomass filtered at 75 µm to 150 µm measured 0.69% CBD.

[00141] **Example II**

[00142] The above methods were carried out and concentrations of phytocannabinoids measured at each stage. The concentration of combined CBD and CBDA was measured at each stage of the method. Untreated biomass measured 0.92% CBD. The biomass after grinding with dry ice measured 0.69% CBD. Biomass filtered at 50 µm and 200 µm measured 0 1.55% CBD. Biomass filtered at 75 µm to 150 µm measured 2.62% CBD.

[00143] **Example III**

[00144] The above methods were carried out on a 10 kg sample of untreated biomass. The 10 kg of biomass resulted in 0.35 kg of pellets.

[00145] **Example IV**

[00146] The above methods were carried out on three samples and concentrations of phytocannabinoids measured for untreated biomass and for pelleted biomass. An average of 96.5% of the structural plant material was removed during generation of the concentrated trichome pellets. The average amount of trichome pellets generated was 350 g per 10 kg of untreated biomass.

[00147] The trichome pellets generated had an average 2.77x increase in the amount of phytocannabinoids, taking into account CBDA, CBD, CBG, THCA and THC, with a range of 1.26x to 4.5x compared with the levels present in the untreated biomass.

[00148] An increase in potency of phytocannabinoid retention in isolated trichome cakes following trichrome isolation was observed.

[00149] In the preceding description, for purposes of explanation, numerous details are set forth in order to provide a thorough understanding of the

embodiments. However, it will be apparent to one skilled in the art that these specific details are not required.

[00150] The above-described embodiments are intended to be examples only. Alterations, modifications and variations can be effected to the particular embodiments by those of skill in the art. The scope of the claims should not be limited by the particular embodiments set forth herein, but should be construed in a manner consistent with the specification as a whole.

CLAIMS:

1. A method of isolating trichomes from structural plant matter comprising:

providing biomass comprising trichomes bound to structural plant material;

combining the biomass with a solution comprising a chelating agent;

agitating the solution and the biomass for separating the trichomes from the structural plant material; and

filtering the solution to remove the structural plant material and at least a portion of the solvent from the trichomes for providing isolated trichomes.

2. The method of claim 1 wherein the biomass has been dried following harvest.

3. The method of any one of claims 1 or 2 wherein providing the biomass comprises milling raw biomass.

4. The method of claim 3 wherein milling the raw biomass comprises milling the raw biomass at a temperature of -20 °C or lower.

5. The method of any one of claims 1 to 4 wherein combining the biomass with the solution comprises combining the biomass with the solution at a chilling temperature of between 2 °C and 6 °C.

6. The method of claim 5, wherein the chilling temperature is 4 °C.

7. The method of any one of claims 1 to 6 wherein the solution comprises a base for providing a pH above 8.0.

8. The method of claim 7 wherein the base comprises NaOH.

9. The method of any one of claims 1 to 6 wherein the solution comprises a buffer for maintaining a selected pH.

10. The method of claim 9 wherein the selected pH is between 6.5 and 14.0.

11. The method of any one of claims 9 or 10 wherein the selected pH is between 7.5 and 13.5.

12. The method of any one of claims 9 to 11 wherein the selected pH is between 8.5 and 13.0.

13. The method of any one of claims 9 to 12 wherein the selected pH is between 9.5 and 12.5.

14. The method of any one of claims 9 to 13 wherein the selected pH is between 10.5 and 12.0.

15. The method of any one of claims 9 to 14 wherein the selected pH is between 11.0 and 11.5.

16. The method of any one of claims 1 to 15 wherein the solution comprises a reducing agent for maintaining the quality of the trichomes.

17. The method of claim 16 wherein the reducing agent comprises L-cysteine.

18. The method of any one of claims 1 to 17 wherein combining the biomass with the solution comprises soaking the biomass in the solution.

19. The method of any one of claim 18 wherein soaking the biomass comprises soaking the biomass at a soaking temperature of between 2 °C and 6 °C.

20. The method of claim 19, wherein the soaking temperature is 4 °C.

21. The method of any one of claims 1 to 20 further comprising, prior to agitating the solution, adding a grinding material to the solution.

22. The method of claim 21 wherein filtering the solution comprises filtering the solution to remove the grinding material.

23. The method of any one of claims 21 wherein the grinding material comprises dry ice.

24. The method of any one of claims 1 to 23 wherein agitating the solution comprises agitation at an agitation temperature of between 2 °C and 6 °C.

25. The method of claim 24, wherein the agitation temperature is 4 °C.

26. The method of any one of claims 1 to 25 wherein agitating the solution comprises application of an agitator selected from the group consisting of a continuous flow agitator, a rotary agitator, a static mixer, an inline high sheer rotor stator homogenizer, a shaker, a vortex mixer, a wafer mixer, a homogenizer, a liquid jet mixing nozzle and a venturi tube fluid jet.

27. The method of any one of claims 1 to 26 wherein agitating the solution comprises application of rotary flow to the biomass solution.

28. The method of any one of claims 1 to 27 wherein agitating the solution comprises application of turbulent flow to the biomass solution.

29. The method of any one of claims 1 to 28 wherein agitating the solution comprises application of laminar flow to the biomass solution.

30. The method of any one of claims 1 to 29 wherein filtering the solution comprises filtering the solution with a coarse filter to filter the structural plant material from the trichomes and the solution; and filtering the solution with a fine filter to filter the trichomes from the solution for providing the isolated trichomes.

31. The method of claim 30 wherein the coarse filter comprises a pore size of between 150 and 250 µm and the fine filter comprises a pore size of between 25 µm and 75 µm.

32. The method of claim 31 wherein the coarse filter comprises a 200 µm filter and the fine filter comprises a 50 µm filter.

33. The method of any one of claims 1 to 32 further comprising dewatering the isolated trichomes to remove residual solvent from the isolated trichomes.

34. The method of claim 33 wherein dewatering the isolated trichomes comprises one or more of centrifuging, vacuum filtering, filter pressing, screw pressing, applying a drying bed to, applying a slurry separator to, or applying a dewatering screen to the isolated trichomes and the residual solution.

35. The method of any one of claims 33 to 34 further comprising, after dewatering the isolated trichomes, pelletizing the isolated trichomes to provide trichome pellets.

36. The method of claim 35 further comprising drying the trichome pellets.

37. The method of claim 36 wherein pelletizing the isolated trichomes comprising rinsing the isolated trichomes with a reducing agent solution.

38. The method of clam 37 wherein the reducing agent solution comprises L-cysteine.

39. The method of any one of claims 33 or 34 further comprising, after dewatering the isolated trichomes, drying the isolated trichomes.

40. The method of any one of claims 33 to 39 further comprising, after dewatering the isolated trichomes, rinsing the isolated trichomes with a second solvent for rinsing the chelating agent out of the isolated trichomes.

41. The method of claim 40 wherein the second solvent comprises water without EDTA and without buffer.

42. The method of any one of claims 40 or 41 wherein rinsing the isolated trichomes comprises rinsing the isolated trichomes at a rinse temperature of between between 2 °C and 6 °C.

43. The method of any one of claims 1 to 42 wherein providing biomass comprises:

filtering untreated biomass with a pre-treatment coarse filter to filter at least a portion of the structural plant material from the trichomes; and

filtering the untreated biomass with a pre-treatment fine filter to at least a portion of the trichomes from the untreated biomass for providing the biomass;

and wherein the pore size of the pre-treatment coarse filter is greater than the pore size of the coarse filter; and

the pore size of the pre-treatment fine filter is smaller than the pore size of the fine filter.

44. The method of claim 43 wherein the pre-treatment coarse filter comprises a pore size of between 150 and 250 µm and the pre-treatment fine filter comprises a pore size of between 25 µm and 75 µm.

45. The method of claim 44 wherein the pre-treatment coarse filter comprises a 200 µm filter, the pre-treatment fine filter comprises a 50 µm filter, the coarse filter comprises a 150 µm filter, the fine filter comprises a 75 µm filter.

46. The method of any one of claims 1 to 45 further comprising combining a surfactant with the solution for breaking connections in the cell walls of the plant matter between the structural plant matter and the trichomes.

47. The method of claim 46 wherein the surfactant comprises sodium dodecyl sulfate.

48. The method of any one of claims 1 to 47 further comprising rinsing the isolated trichomes with a reducing agent solution.

49. The method of clam 48 wherein the reducing agent solution comprises L-cysteine.

50. The method of any one of claims 1 to 49 further comprising, after agitating the solution and the biomass for separating the trichomes from the structural plant material, repeating the method of any one of claims 1 to 49 wherein combining the biomass with the solution comprises combining the structural plant material with the solution.

51. The method of any one of claims 1 to 49 further comprising, after filtering the solution to remove the structural plant material and at least a portion of the solvent from the trichomes for providing isolated trichomes, repeating the method of any one of claims 1 to 49 wherein combining the biomass with the solution comprises combining the structural plant material with the solution.

52. A system for isolating trichomes from structural plant matter comprising:

a mixing tank for receiving biomass comprising trichomes bound to structural plant material and a solution comprising a chelating agent;

an agitator in communication with the mixing tank for agitating the solution to separate the trichomes from the structural plant material;

a coarse filter in fluid communication with the mixing tank for removing the structural plant material from the trichomes and the solution; and

a fine filter in fluid communication with the mixing tank downstream of the coarse filter for removing the at least a portion of the solution from the trichomes and providing the isolated trichomes.

53. The system of claim 52 wherein the agitator comprises an agitator selected from the group consisting of a continuous flow agitator, a rotary agitator, a static mixer, an inline high sheer rotor stator homogenizer, a shaker, a vortex mixer, a wafer mixer, a homogenizer, a liquid jet mixing nozzle and a venturi tube fluid jet.

54. The system of any one of claims 52 or 53 wherein the agitator applies flow selected from the group consisting of rotary flow, turbulent flow or laminar flow.

55. The system of any one of claims 52 to 54 wherein the coarse filter and the fine filter comprise a shaker sieve.

56. The system of any one of claims 52 to 54 wherein the coarse filter comprises a trommel.

57. The system of any one of claims 52 to 56 further comprising a dewatering system in fluid communication with the agitator for dewatering the isolated trichomes to remove residual solution from the isolated trichomes.

58. The system of claim 57 wherein the dewatering system comprises a system selected from the group consisting of a multidisc roller system, a belt press, a piston press, inline filters, an auger screw press, a gravity thickener, a dewatering centrifuge, a vacuum filter, a filter press, a sludge screw press, a screw press separator, a drying bed, a solid liquid separator, a slurry separator, dewatering equipment and a dewatering screen.

59. The system of any one of claims 52 to 58 further comprising a cryogenic hammer mill in communication with the mixing tank for pulverizing raw biomass to produce the biomass and providing the biomass to the mixing tank.

60. The system of any one of claims 52 to 59 further comprising a water agent tank for providing water to the mixing tank.

61. The system of any one of claims 52 to 60 further comprising a chelating agent tank for providing the chelating agent to the mixing tank.

62. The system of any one of claims 52 to 61 further comprising a base tank for providing a base to the mixing tank for increasing a pH value of the solution.

63. The system of any one of claims 52 to 62 further comprising a surfactant tank for providing surfactant to the mixing tank.

64. The system of any one of claims 52 to 63 further comprising a venturi downstream of the mixing tank and upstream of the coarse filter for separating the trichomes from the structural plant matter.

65. The system of any one of claims 52 to 64 further comprising a static mixer downstream of the mixing tank and upstream of the coarse filter for separating the trichomes from the structural plant matter.

66. The system of any one of claims 52 to 65 further comprising a turbulent bash tube downstream of the mixing tank and upstream of the coarse filter for separating the trichomes from the structural plant matter.

67. The system of any one of claims 52 to 66 further comprising a trommel downstream of the mixing tank and upstream of the coarse filter, the trommel comprising a pore size greater than the pore size of the coarse filter for filtering out structural plant matter upstream of the coarse filter.

68. The system of any one of claims 52 to 67 further comprising, upstream of the mixing tank

a pre-treatment coarse filter for removing at least a portion of the structural plant material from the trichomes; and

a pre-treatment fine filter to filter the trichomes from the untreated biomass for providing the biomass;

and wherein the pore size of the pre-treatment coarse filter is greater than the pore size of the coarse filter; and

the pore size of the pre-treatment fine filter is smaller than the pore size of the fine filter.

69. The system of claim 68 wherein the pre-treatment coarse filter comprises a pore size of between 150 and 250 µm and the pre-treatment fine filter comprises a pore size of between 25 µm and 75 µm.

70. The system of claim 69 wherein the pre-treatment coarse filter comprises a 200 µm filter, the pre-treatment fine filter comprises a 50 µm filter, the coarse filter comprises a 150 µm filter, the fine filter comprises a 75 µm filter.

71. A method of isolating trichomes from structural plant matter comprising:

providing biomass comprising trichomes bound to structural plant material;

combining the biomass in a solution at a pH of between 8.0 and 14.0 and a chelating agent;

agitating the solution at an agitation temperature of between 2 °C and 6 °C for separating the trichomes from the structural plant material;

filtering the solution comprises filtering the solution with a coarse filter to filter the structural plant material from the trichomes and the solution; and

filtering the solution with a fine filter to filter the trichomes from the solution for providing the isolated trichomes.

72. The method of claim 71 further comprising the additional features of any one of claims 1 to 51.

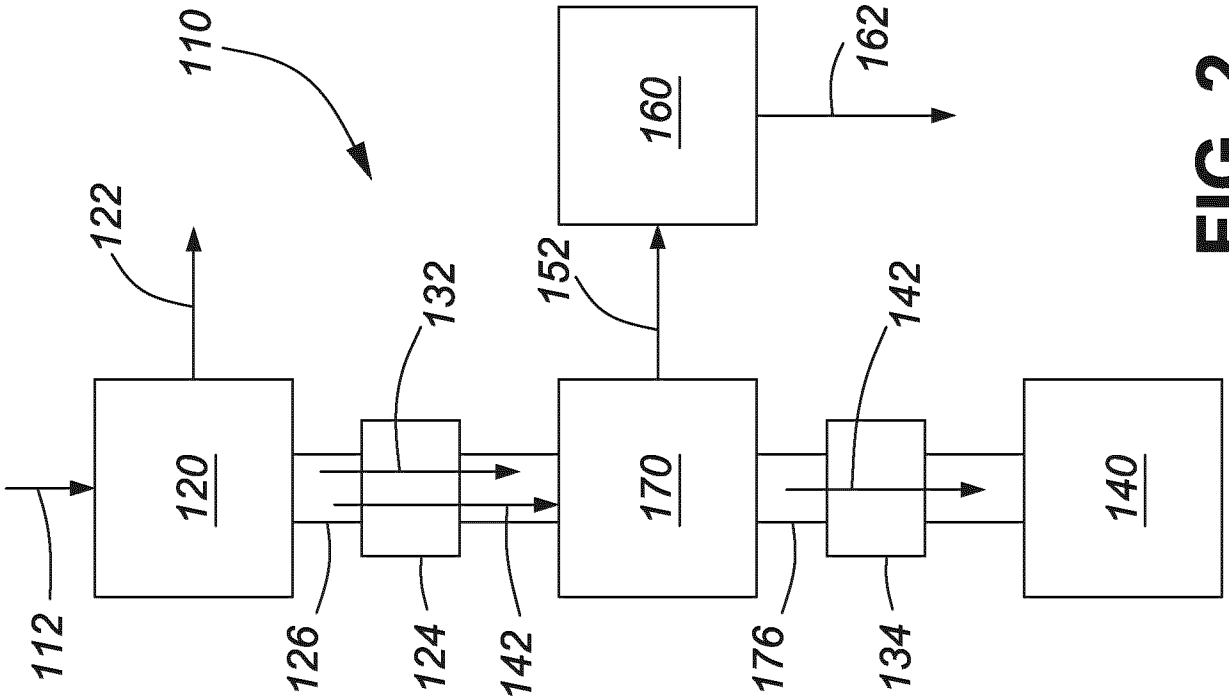
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FIG. 2

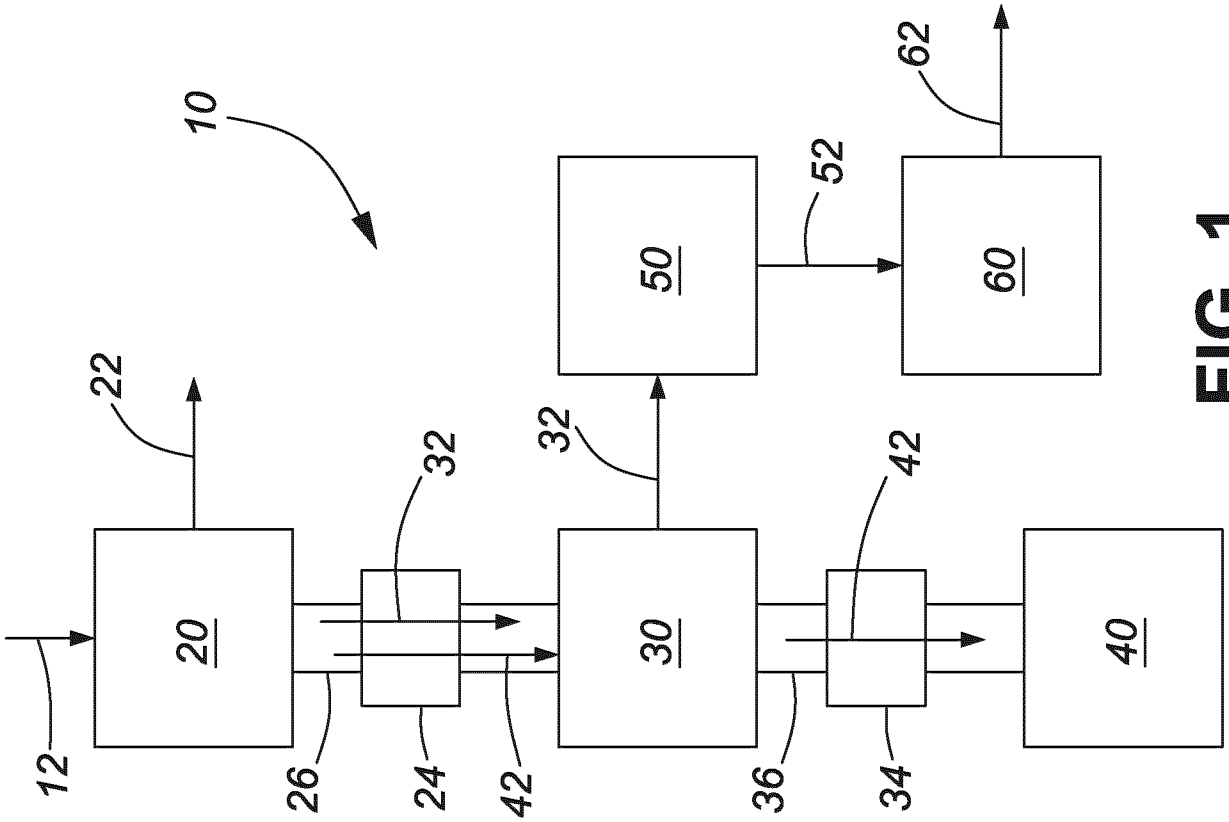
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FIG. 1

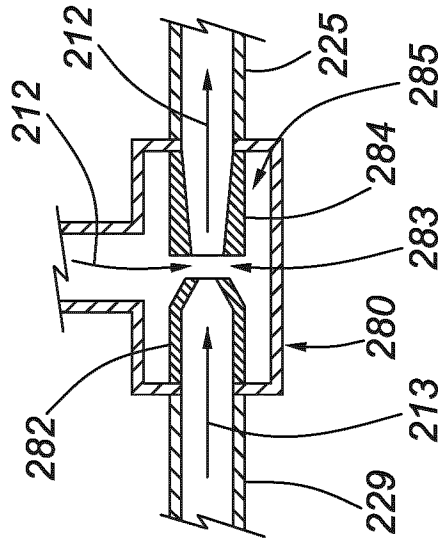
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FIG. 4

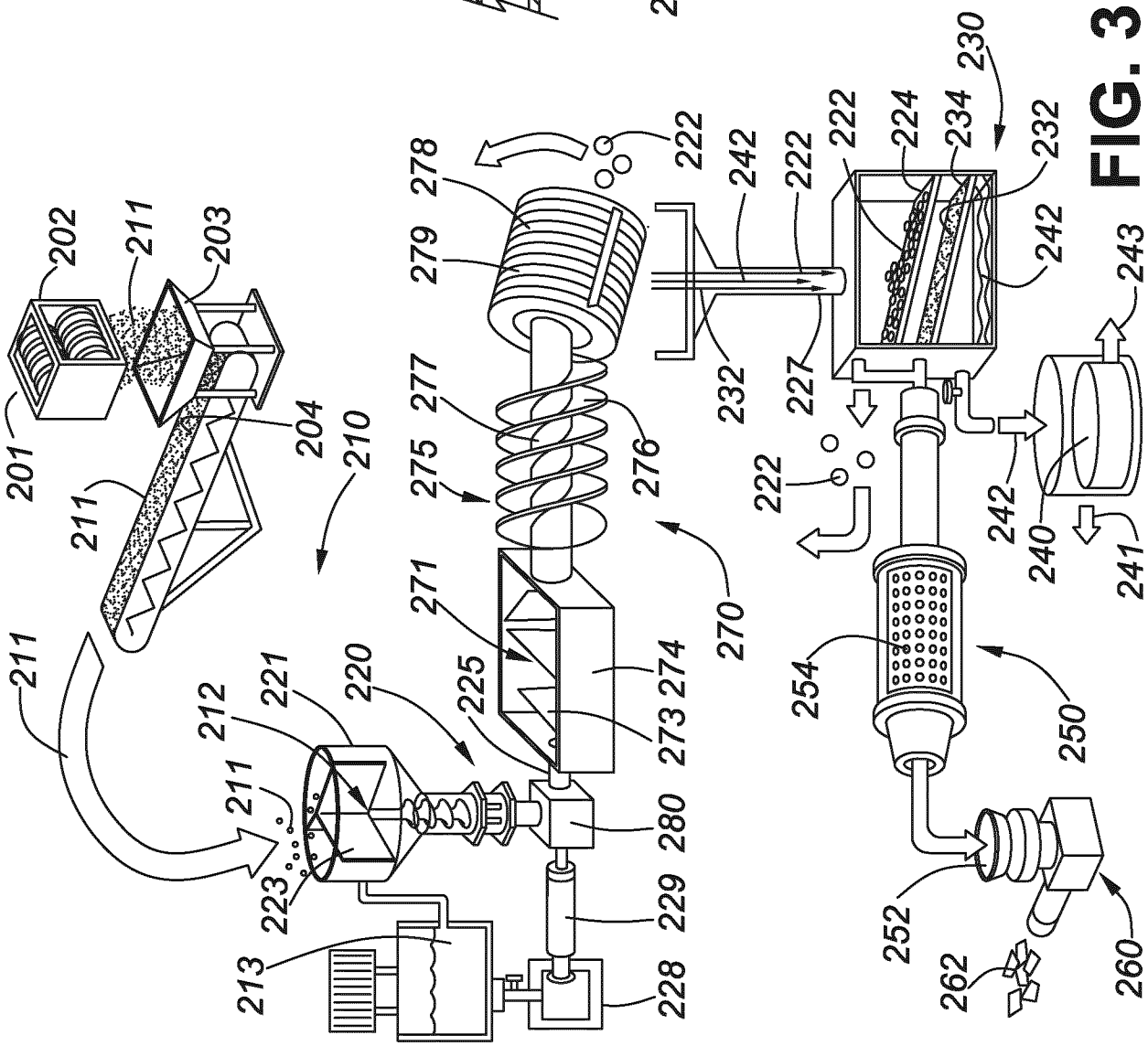
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FIG. 3

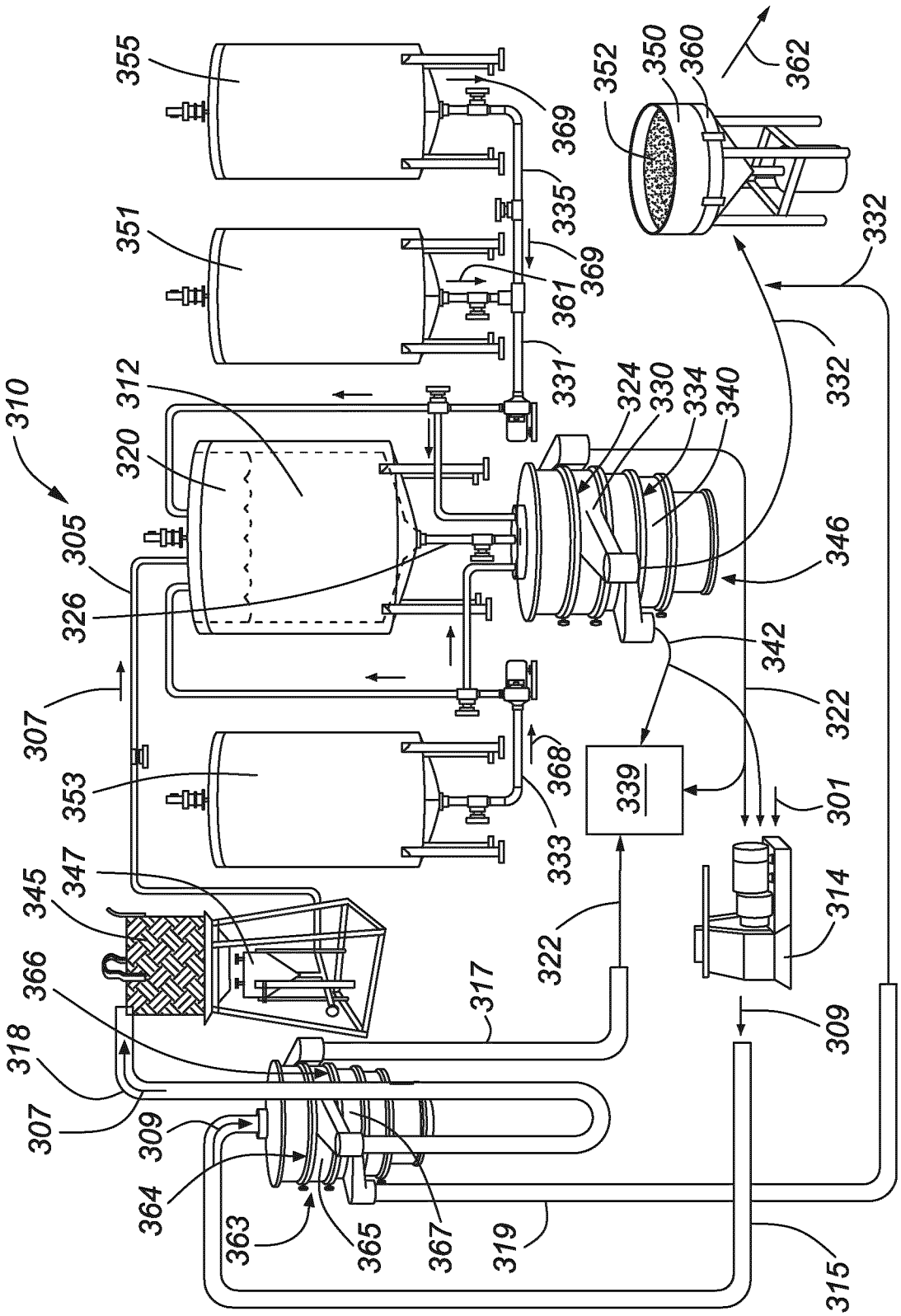
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FIG. 5

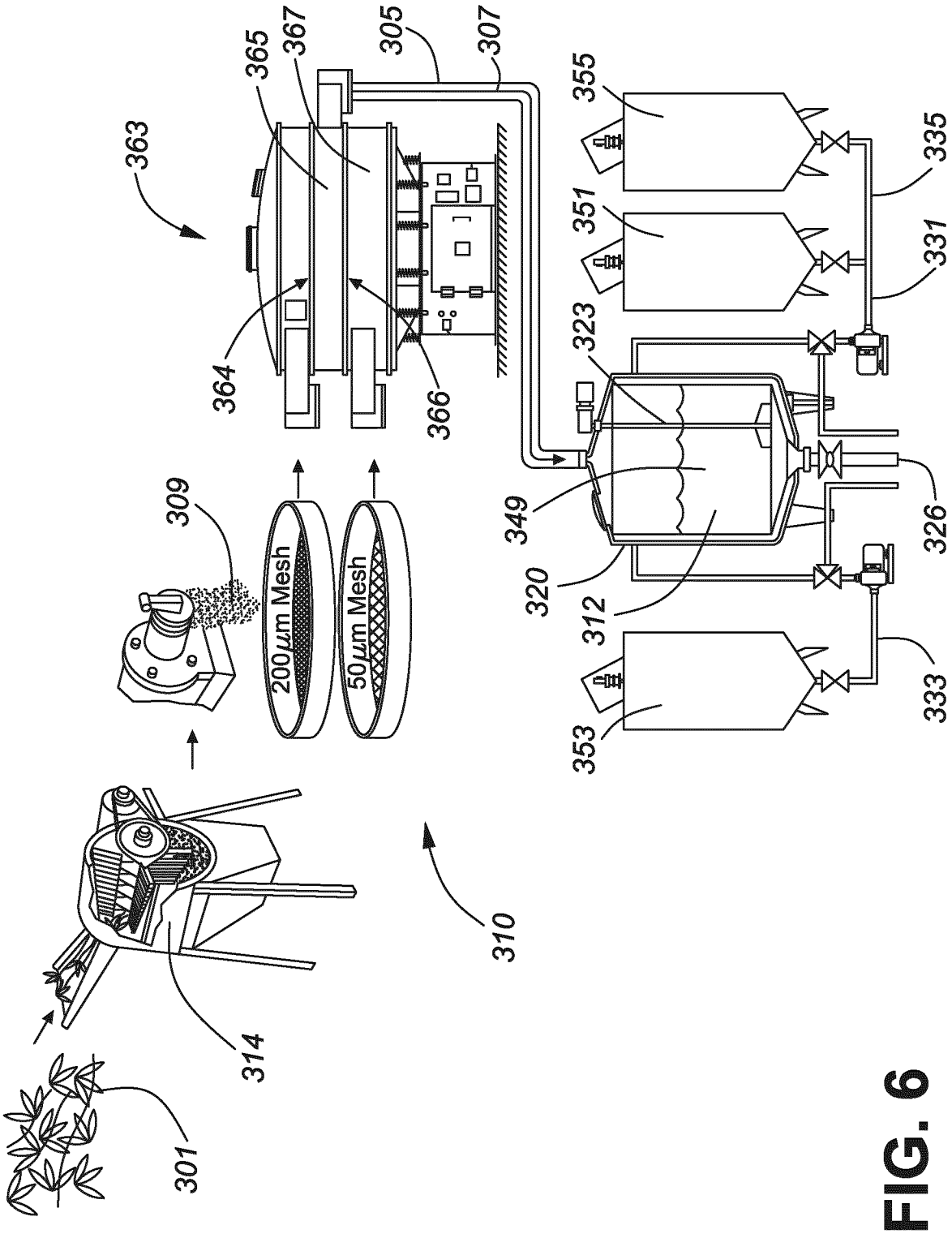
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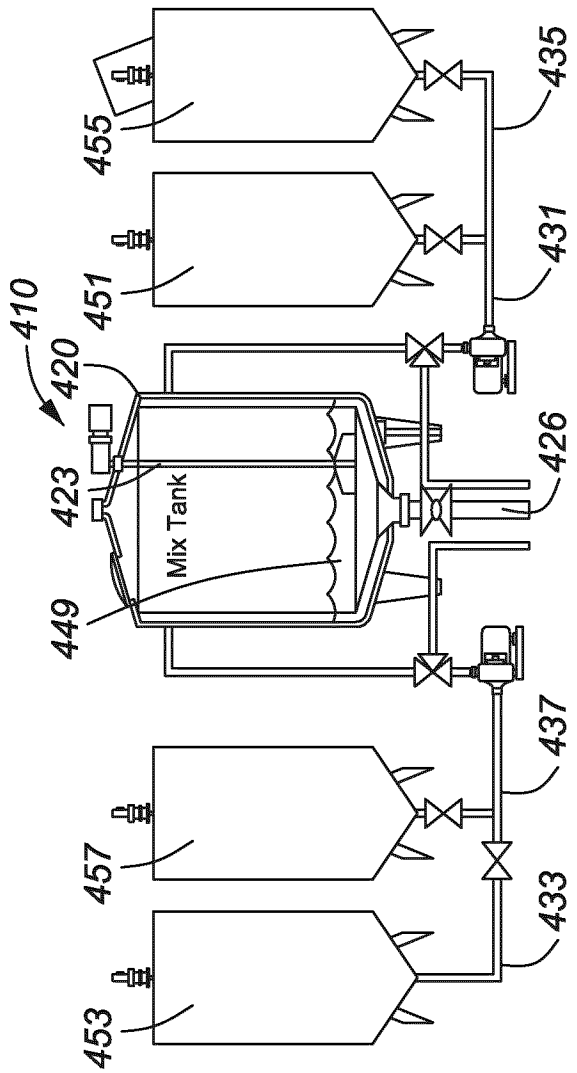
FIG. 6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Mix Tank
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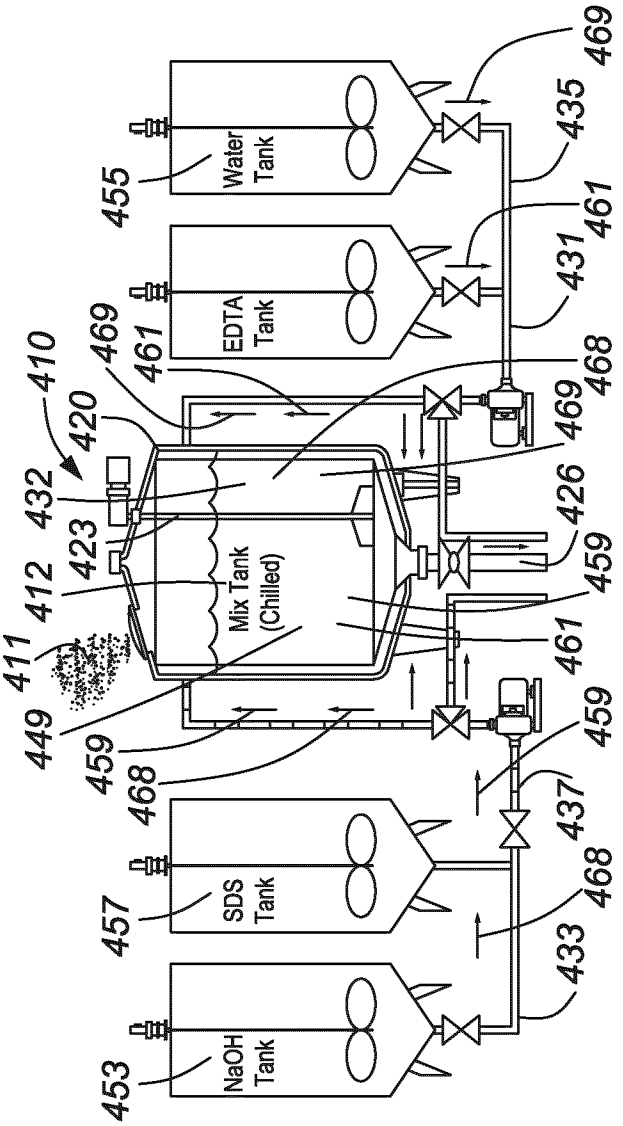
FIG. 7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Mix Tank
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FIG. 8

FIG. 9

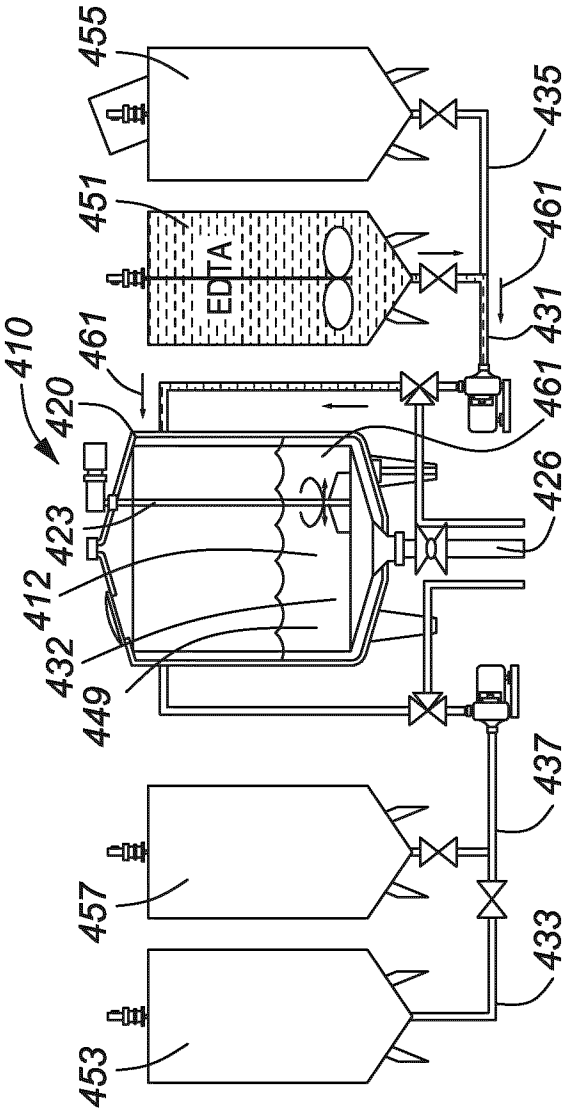
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FIG. 10

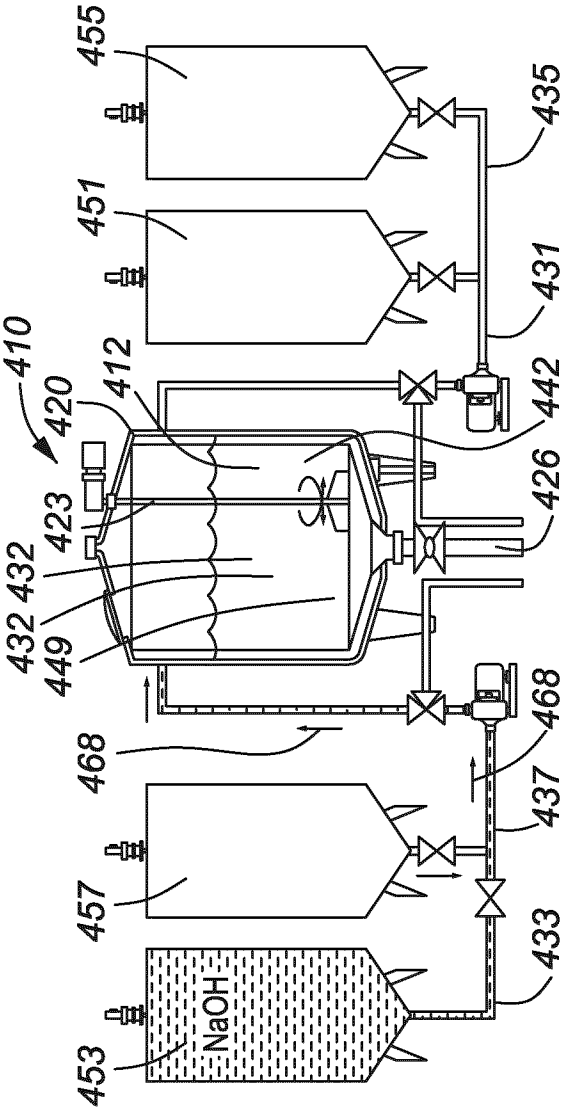
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FIG. 11

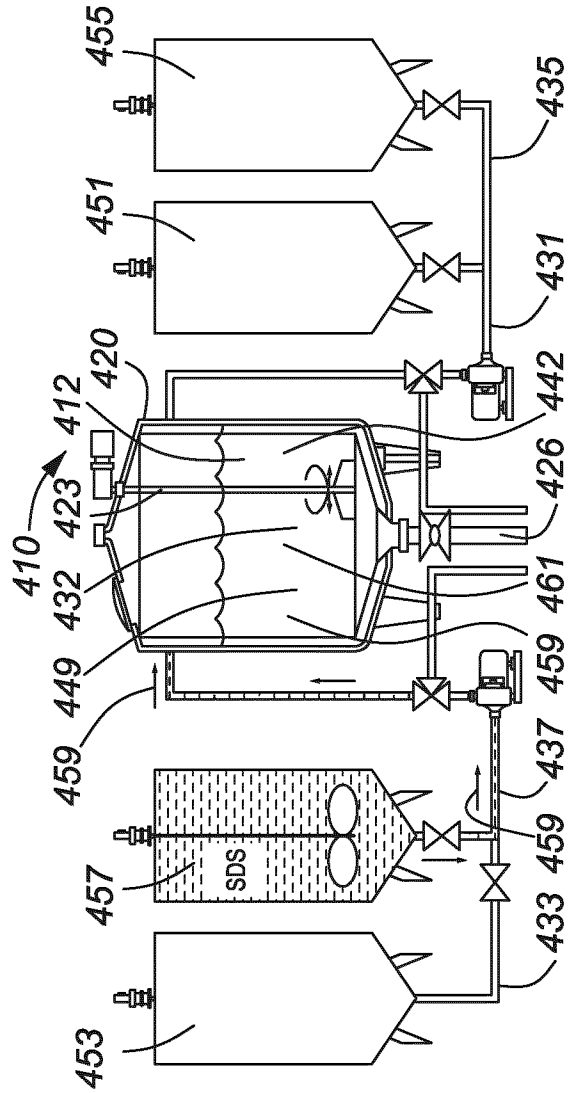
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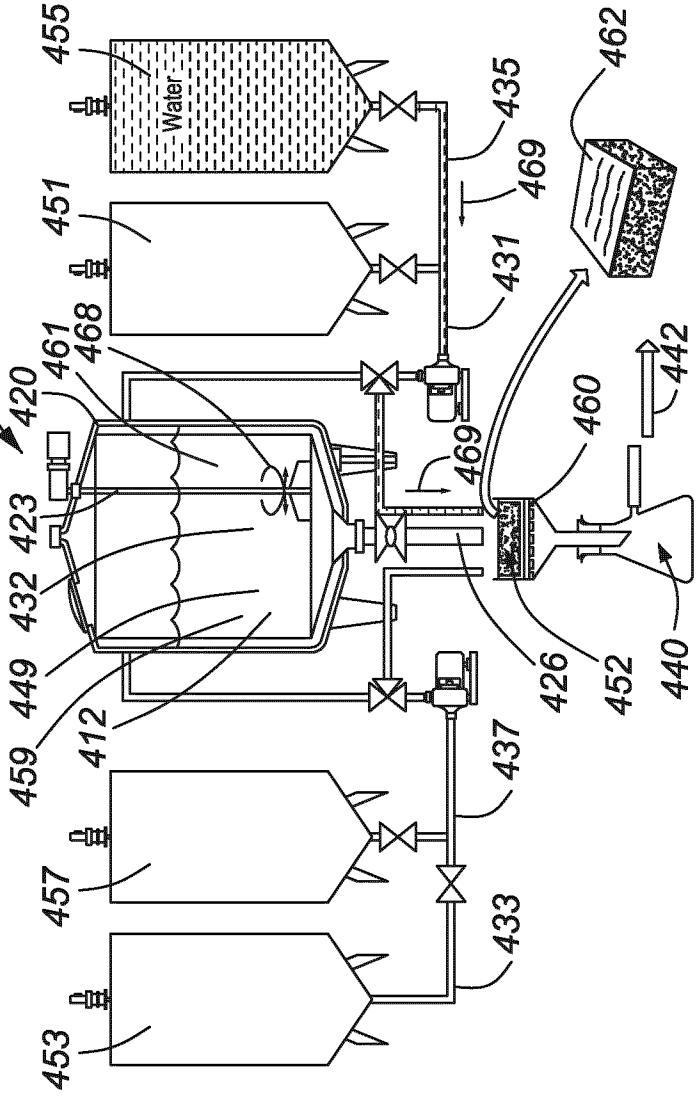
FIG. 12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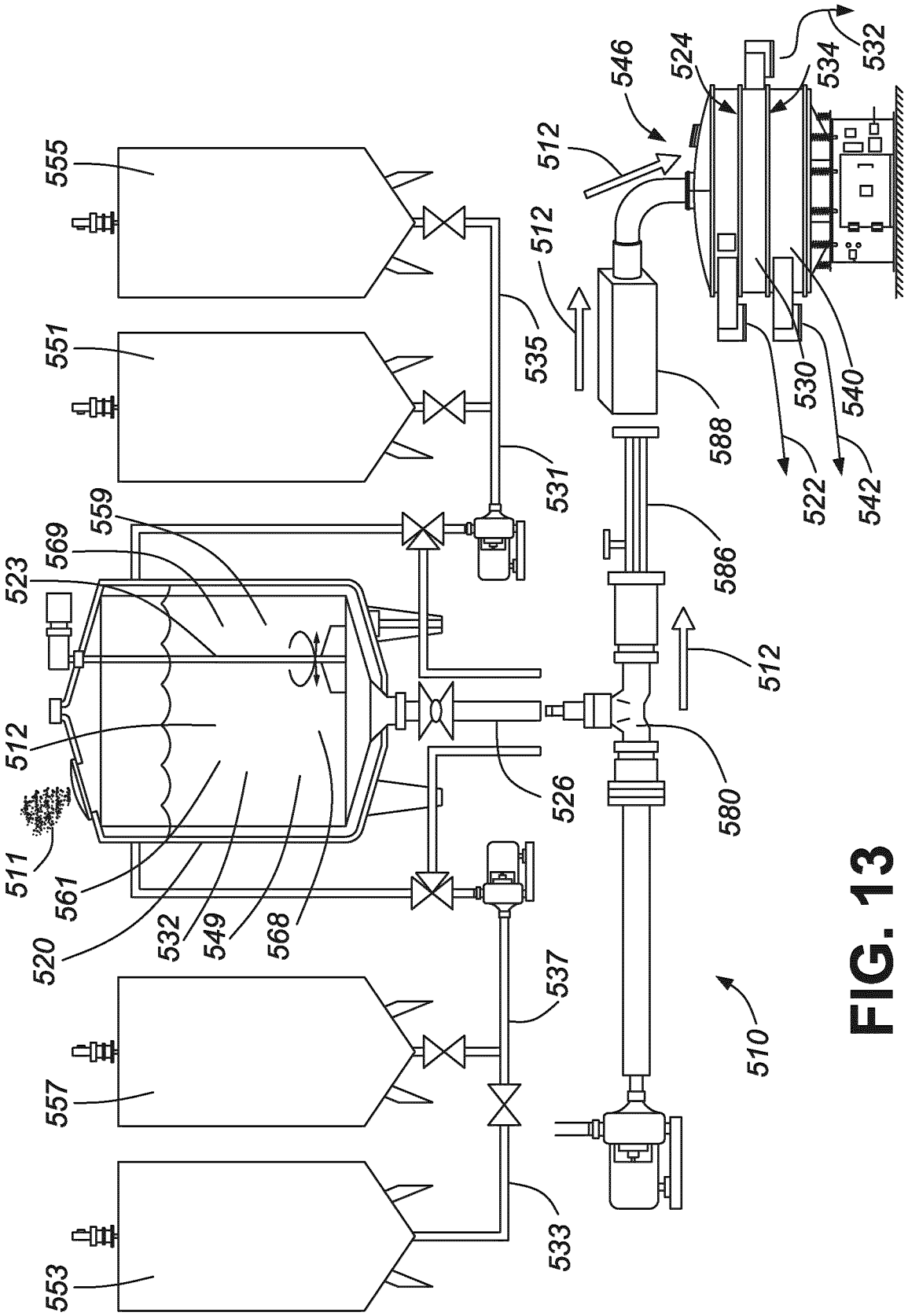
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FIG. 13

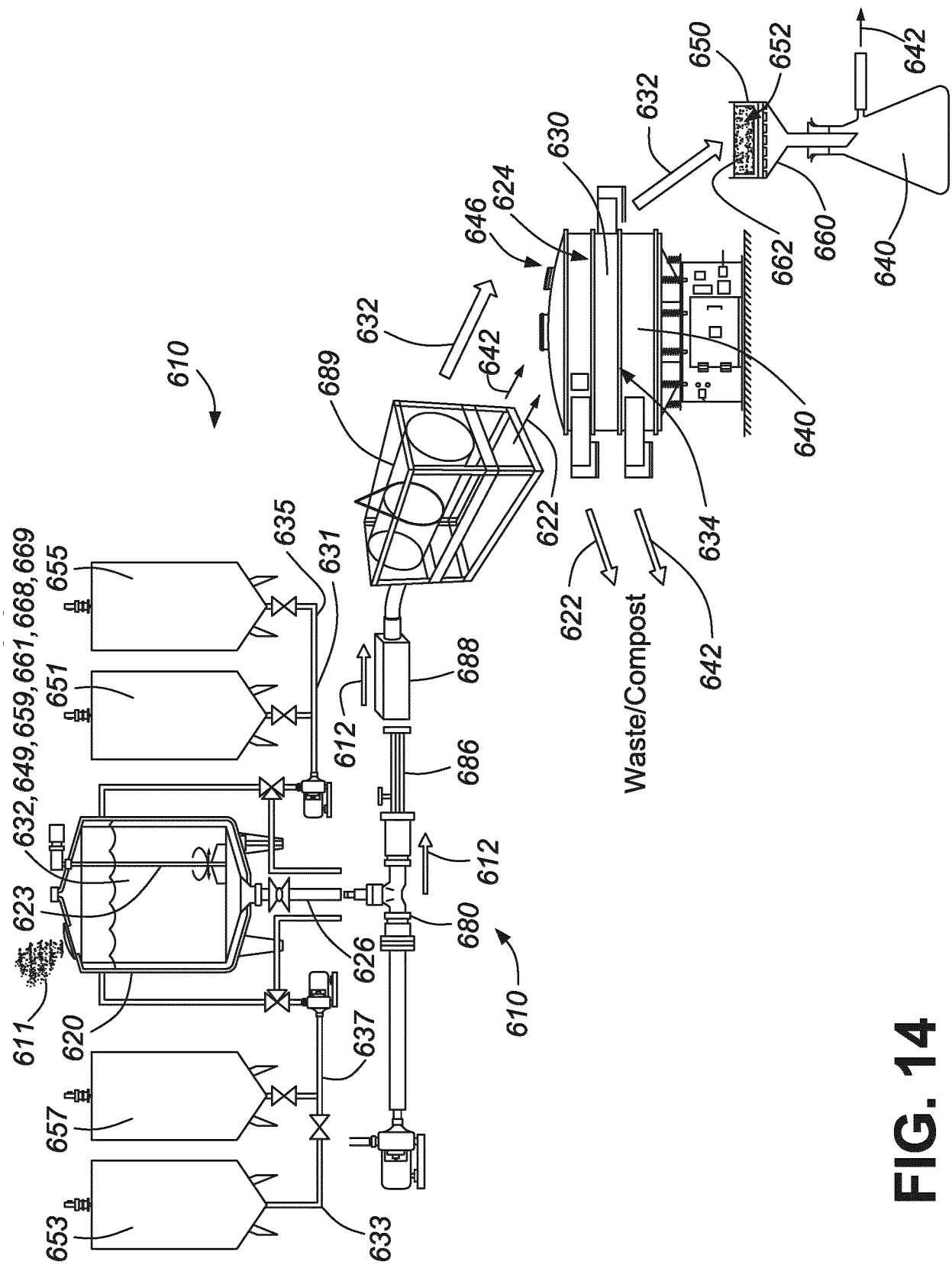
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FIG. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2020/050817

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***A61K 36/00*** (2006.01), ***A23L 33/105*** (2016.01), ***A23N 15/00*** (2006.01), ***A61K 31/05*** (2006.01), ***A61K 31/352*** (2006.01), ***A61K 36/185*** (2006.01) (more IPCs on the last page)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Keyword search across whole IPC

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)

Databases: ORBIT/QUESTEL, STN/CAPLUS, CANADIAN PATENT DATABASE, CIPO LIBRARY DISCOVERY TOOL, PUBMED, GOOGLE PATENT;
Keywords: Biomass, large-scale, trichome, chelating agent, EDTA, EGTA, reducing agent, L-cysteine, NaOH, Cannabis, sativa, hashish

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 8640877 B1 (PASTORIUS, E.B.) 4 February 2014 (04-02-2014) See whole document	1-15, 18-36, 39-47, 50, 51, 71 and 72
Y	US 2011/0256245 A1 (ROSENBLATT, S. et al.) 20 October 2011 (20-10-2011) See whole document	1-15, 18-36, 39-47, 50, 51, 71 and 72

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

*	Special categories of cited documents:
"A"	document defining the general state of the art which is not considered to be of particular relevance
"D"	document cited by the applicant in the international application
"E"	earlier application or patent but published on or after the international filing date
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O"	document referring to an oral disclosure, use, exhibition or other means
"P"	document published prior to the international filing date but later than the priority date claimed
"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&"	document member of the same patent family

Date of the actual completion of the international search 06 September 2020 (06-09-2020)	Date of mailing of the international search report 08 September 2020 (08-09-2020)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 819-953-2476	Authorized officer Qianfa Chen (819) 639-7783

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	ZHANG, X. and OPPENHEIMER, D.G. "A simple and efficient method for isolating trichomes for downstream analyses". Plant Cell Physiol. February 2004 (02-2004), Vol 45 (2), pp.221-224, ISSN: 0032-0781. See whole document	1-15, 18-36, 39-47, 50, 51, 71 and 72
Y	AYTASHEVA, Z.G. "Isolation of trichomes from wheat and other species of flowering plants". Turkish Journal of Botany. January 2006 (01-2006), Vol 30(3), pp.217-222, ISSN: 1300-008X. See whole document	1-15, 18-36, 39-47, 50, 51, 71 and 72
A	US 2018/0007852 A1 (ROSE, M.J.) 11 January 2018 (11-01-2018) See whole document	1-72
A	US 2020/0261824 Al (PAL, K. et al.) 20 August 2020 (20-08-2020) See whole document	1-72
A	YERGER, E.H. et al. "A rapid method for isolating glandular trichomes". Plant Physiol. May 1992 (05-1992), Vol 99(1), pp.1-7, ISSN: 0032-0889. See whole document	1-72
A	US 2019/0281872 A1 (CILIA, D.M.) 19 September 2019 (19-09-2019) See whole document	1-72
A	US 2019/0283038 A1 (CILIA, D.M.) 19 September 2019 (19-09-2019) See whole document	1-72

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US8640877 B1	04 February 2014 (04-02-2014)	None	
US2011256245 A1	20 October 2011 (20-10-2011)	US9066910 B2	30 June 2015 (30-06-2015)
		US2015258153 A1	17 September 2015 (17-09-2015)
US2018007852 A1	11 January 2018 (11-01-2018)	US10375892 B2	13 August 2019 (13-08-2019)
US2020261824 A1	20 August 2020 (20-08-2020)	WO2020168413 A1	27 August 2020 (27-08-2020)
US2019281872 A1	19 September 2019 (19-09-2019)	US9718065 B1	01 August 2017 (01-08-2017)
		US10300494 B1	28 May 2019 (28-05-2019)
		US2019283038 A1	19 September 2019 (19-09-2019)
US2019283038 A1	19 September 2019 (19-09-2019)	US9718065 B1	01 August 2017 (01-08-2017)
		US10300494 B1	28 May 2019 (28-05-2019)
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B01D 11/02 (2006.01) , ***B01D 37/00*** (2006.01) , ***C07C 39/23*** (2006.01) , ***C07D 311/80*** (2006.01)