Cosmetics & Bio-Products:

Organic extracts for purer formulations

Why Cosmetics?

Cosmetic products are complex mixtures of ingredients with different physical, chemical and functional properties formulated in order to obtain the product with desired activity and quality.

Cosmetic product manufacturers can now move from synthetic to plant-based ingredients (also known as ingredients of plant-origin) in order to increase product purity and quality, with the use of the novel Supercritical Fluid CO_2 Extraction (SCFE).

The Extraction Advantage

Supercritical Fluid CO_2 Extraction is a promising extraction technique that helps replace the organic toxic solvents previously in use in the industry (such as chloroform, dichloromethane, diethyl ether, methanol etc.).

Due to its unique properties, the desirable texture, absence of water or solvent traces, chemical stability and presence of bioactive agents, SCFE extracts can be easily incorporated into cosmetic products. Moreover, SCFE provides a high concentration of bioactive compounds which exhibit many bioactivities in cosmetic products, such as antioxidants, anti-ageing, photo-protective agents or providing antibacterial activity.

SCFE is an environmentally friendly extraction technique based on the application of generally regarded as safe (GRAS) solvent CO_2 and high pressures which has many advantages over the conventional processes.

Requirements in Extraction

- Lower adulteration in extraction process.
- The extracted solvent should have higher bioactive and lower residues.
- The output should be chemical free.
- Multiple recipe selection.
- Clean, safe and Green Technology.
- Robust process and monitor controlling.
- Operational safety.
- Minimal human intervention.

Buffalo Extraction Systems Solution

Three levels of CO_2 SCFE equipment

Level 1

Level 2

Level 3

01

Accurate Pressure Control

02

Consistent Flow Control

03

Superior Sealing Technology

04

Unique Extractor Closure Design

05

Special Separator Design

06

Proprietary Changeover Valves

Bringing the Future of Extraction to the World

Our team starts by blending principles with practicalities and continue by connecting proven automation process blocks into a holistic solution.

- **Integration**: Combining scientific and engineering principles with a rich and diversified practical experience to provide innovative solutions to challenges.
- **Modularity**: Automation based on proven process blocks.
- **Connectivity**: Linking equipment and control systems via PCs and PLCs for seamless operation.

System Specifications

Parameters	Level 1	Level 2	Level 3
Single Extractor Volume (Litre)	5	25	100 / 200 / 300
No. of Extractors	2	2 or 3	2 or 3
Extractors Usage	Single	Single or Series	Single or Series
Pressure Bar (PSI)	350 – 650 (5000 – 9500)	350 – 650 (5000 – 9500)	350 – 650 (5000 – 9500)
Temperature — °C (°F)	70 – 110 (158 – 230)	70 – 110 (158 – 230)	70 – 110 (158 – 230)
CO_2 Recirculation	Yes	Yes	Yes
Extractor Changeover Valves	Manual or Automatic	Automatic	Automatic
CO_2 Pump Flowrate (LPH)	40 -80	150 -350	600 -3000
Co-Solvent Pump	Yes	Yes	Yes
CO_2 Feeding & Recovery System	Included	Included	Included
Available Certifications	CE / U / U2 cGMP / ASME BPE / UL / SIL-3	CE / U / U2 cGMP / ASME BPE / UL / SIL-3	CE / U / U2 cGMP / ASME BPE / UL / SIL-3
Area Required* (m/ft)	4.88 x 1.37 x 2.44 / 16 x 4.5 x 8	8 x 2.8 x 5.6 / 26 x 27 x 18.5	13.7 x 7.9 x 8 / 45 x 26 x 27

*** All systems can be customized based on the factory layout.**

Common Bioactive Compounds Used in Cosmetics

Most relevant recent studies on the supercritical CO_2 extraction of bioactive compounds from plant materials with application in cosmetic products:

Scientific Name	Common Name	Targeted Compounds	Reported Activities	SCO_2 Extraction Conditions
Copaifera sp.	**Copaíba leaf**	Essential oils	Antioxidant activities and antimicrobial activity, inhibition tyrosinase	35 MPa, 75 °C, 4 h
Synadenium grantii Hook f.	**Mountain Tea**	Euphol, carvacrol, betulin aldehyde, and friedelan-3-one	Antioxidant activity	15–25 MPa, 40–80 °C, 1 h, co-solvent EtOH
Sideritis sipylea Boiss	-	n-nonacosane, n-hexacosane and sideridiol, geranyl linalool	Anti-tyrosinase and anti- elastase activity, antioxidant activity	30 MPa, 35–40 °C, 2 h, 25 g CO_2/min
Prunus avium	**Sweet cherry stems**	Fatty acid derivatives and terpenes, catechin, chrysin, and Naringenin.	Scavenging peroxyl free radicals	15 MPa, 40 °C, 1 h, co-solvent EtOH
Rubus idaeus L.	**Red raspberry seeds**	Ω-3 fatty acids, tocopherol	Inhibition of aflatoxin activity	30 MPa, 40 °C, 3 h, 0.194 kg CO_2/h,
Humulus Lupulus Stramonium	**Hops and Datura (leaves and flowers)**	Volatile oils, terpenes, terpenoids, fatty acids, and bitter acids	Antibacterial activity against Escherichia coli	30 MPa, 70 °C, 5 h.
Camellia sinensis var. assamica	**Assam tea seeds**	Vegetable oil, phenolic compounds	Low antioxidant activity	17.5–22.5 MPa, 40–60 °C, 110–170 L CO_2/h
Solidago gigantea Ait.	**Goldenrod**	Vegetable oil, phenols, chlorophyll	Antibacterial activity Low level of cytotoxicity	20–80 MPa, 331.15–353.15 K, 3–7 kg CO_2/h
Curcuma aromatica Salisb	**Wild turmeric**	Terpenes (p-cymene, β turmerone, curdione)	Antioxidant, anti-inflammatory, anti-lipoxygenase activity and antibacterial activity	10–40 MPa, 40–65 °C, 1 h, 2 L CO_2/min

Scientific Name	Common Name	Targeted Compounds	Reported Activities	SCO_2 Extraction Conditions
Artocarpus heterophyllus	**Brazilian jackfruit**	13,27-cycloursan-3-one,9,19 cyclolanost-24-en-3-ol and lanosterol	Antioxidant activity, antifungal activity	12–20 MPa, 40–50 °C, 150 min, 3.0 and 4.0 mL CO_2/min
Capsicum annuum L.	**Pepper seed**	Vegetable oil (linoleic, palmitic and oleic acids, tocopherol)	Antioxidant activity	100 MPa, 40 °C, 2 h, 0.40 L/min CO_2
Rosmarinus officinalis L.	**Rosemary**	α-pinene, camphene, β-pinene, eucalyptol	-	8.2 MPa, 35 °C, 30 min, 100 mL CO_2/min
Lavandula luisieri	**Spanish lavender**	Essential oil, rosmarinic acid, ursolic acid and oleanolic acid	Antimicrobial activity, antioxidant activity	13 MPa, 30 g CO_2/min
Amaranthus spp	**Amaranth seed**	Squalene, triacylglycerols	Antifungal activity	7 MPa, 65 °C, 18 kg CO_2/h
Ocimum basilicum L.	**Basil**	Volatile oils	Antioxidant activities Inhibition of acetylcholinesterase and tyrosinase	9 MPa, 313 K, 2.5 h, particle size 0.6 mm
Lycium ruthenicum Murr	**Russian box thorn**	Vegetable oil (unsaturated fatty acid, β carotene, tocopherol and total phenolics)	Antioxidant activity	26 MPa, 55 °C, 1 h, 80 L CO_2/h, particle size: 0.6 mm
Picea Abies	**Norway spruce bark**	Resin acids, stilbens, astringin and piceid, β-sitosterol	Antimicrobial and antifungal activity, antioxidant activity	48 MPa, 80 °C, 1 h, co-solvent EtOH
Lavandula Officinalis and Hypericum Perforatum	**Lavender and Centaury**	1,2-benzenedicarboxylic acid, n-tetratriacontane, linalool, linalyl acetate	Antimicrobial activity, antioxidant activity	10 MPa, 40 °C
Theobroma cacao	**Cocoa bean**	Phenols	Antioxidant activity	20 MPa, 50 °C, 2 h 11 g CO_2/min

Scientific Name	Common Name	Targeted Compounds	Reported Activities	SCO_2 Extraction Conditions
Dialium cochinchinense Cinnamomum cambodianum, Gardenia angkorensis Pitard, Cananga latifolia Gagnep, and Oroxylum indicum (L.)	**Khmer medicinal plants (Pierre, Lecomte, Pitar, Finet, Kurz bark)**	Phenols	Antioxidant activity	10 MPa, 150 °C, 4 h, 0.15 mL CO_2/min
Zea mays	**Corn germ**	Lecithin	Emulsification activity	30 MPa, 50 °C, 2 h, 25 L CO_2/h
Sesamum indicum, L.	**Sesame seeds**	Γ-tocopherol, lignin, polyphenols	Antioxidant activity	30 MPa, 60 °C, 1.5 h, 0.5 L CO_2/min
Rubus fruticosus	**Blackberry seeds**	Phytosterols, tocopherol	Antioxidant activity	30 MPa, 50 °C, 2.5 h, 80 kg CO_2/h
Matricaria chamomilla	**Chamomile**	Umbelliferone, herniarin	Antioxidant activity	30 MPa, 40 °C, 1.5 h, 2 kg CO_2/h
Medicago sativa L.	**Lucerne or alfalfa**	Flavonoids, oleanolic acid equivalents, saponins	Antioxidant activity	10 MPa, 50 °C, 1 h, 4 mL CO_2/min, co-solvent EtOH
Hippophae rhamnoides L.	**Buckthorn**	Flavonoids, carotenoid, polyphenol, tocopherol	Antioxidant activity Prolonged oxidant stability	40 °C, 30 MPa, 90 min, 0.5 L CO_2/min
Eugenia involucrata	**Eugenia**	Essential oils β-elemene and bicyclogermacrene, vitamin E	Antioxidant activity	20 MPa, 80 °C, 50–80 min
Opuntia ficus-indica L.	**Prickly pear Cactus, nopal**	Vegetable oil (vaccenic acid)	Antioxidant and antibacterial activities	35 MPa, 40 °C, 8.5 kg CO_2/h
Helichrysum italicum (Roth) G. Don, Angelica archangelica L., Lavandula officinalis L., Salvia officinalis L., Melilotus officinalis L., and Ruta graveolens L	**Immortelle, angelica, lavender, sage, sweet clover, rue**	Coumarin	Antioxidant activity	15–30 MPa, 40 °C, 1.95 kg CO_2/h
Rubus idaeus	**Raspberry pomace**	Phenols, linoleic and linolenic acid	Antioxidant activity	10–45 MPa, 30–60 °C, 30–120 min, 2 L CO_2/min
Cytisus scoparius L.	**Broom**	Flavonoids, phenolic acids and phenolic aldehydes	Antioxidant activity	25 MPa, 45 °C, 25 g CO_2/min, co-solvent EtOH

Scientific Name	Common Name	Targeted Compounds	Reported Activities	SCO_2 Extraction Conditions
Moringa oleifera	**Moringa**	Vegetable oil	Antioxidant activity	5–40 MPa, 25–35 °C, 5 h 20 kg CO_2/h
Zea mays	**Corn germ**	Lecithin	Emulsification activity	30 MPa, 50 °C, 2 h, 25 L CO_2/h
Coffea canephora L.	**Spent coffee bean**	Vegetable oil	Sunscreen water resistance activity, photoprotective activity	25 MPa, 55 °C, 15 kg CO_2/h, 1 h
Helichrysum italicum	**Immortelle**	Tremetone derivatives, squalene	-	8–22 MPa, 36–64 °C, 1.94 kg CO_2/h
Helichrysum italicum (Roth)	**Immortelle**	Scopoletin	Antioxidant activity	7.93–22.07 MPa, 35.86–64.14 °C, 90 min, 1.94 kg CO_2/h
Copaifera sp	**Copaíba**	Volatile oils	Antioxidant activity, anti- inflammatory and neuroprotective effects	10–30 MPa, 40–60 °C, 0.000833 kg CO_2/s
Vitis vinifera	**Grape marc**	Polyphenols	Antioxidant activity	8 MPa, 20–80 °C, 4–10 min, 6 kg CO_2/h
Lippia sidoides Cham	**Pepper rosmarin seeds**	Polyphenols, flavonoids	Antioxidant activity	40 MPa, 60 °C, 1.5 L CO_2/min
Oryza sativa L.	**Rice bran**	Linoleic acid, oryzanol,policosanol, and tocotrienol	5-alpha-reductase inhibition	32 °C and 27 MPa, 240 min, 135 g CO_2/min
Calendula officinalis	**Marigold**	Pentacyclic triterpene monols, diols, monoester faradiol, diester myristic, palmitic and lauric acids	Skin and wound healing, antimicrobial activity	-
Hevea Brasiliensis	**Rubber seeds oil**	α-linolenic acid	Moisturizing and stability in cosmetic products	60 °C, 30 MPa, 4 mL CO_2/min
Cannabis sativa ssp. sativa	**Hemp seed**	Linoleic acid, γ-linolenic, and α-linolenic	Moisturizing	30 and 40 MPa, 40, 60 and 80 °C

Scientific Name	Common Name	Targeted Compounds	Reported Activities	SCO_2 Extraction Conditions
Sesamum indicum L.	**Sesame seed**	Oleic linoleic, palmitic and stearic acid	Moisturizing	50 °C, 350 bar, 2 mL CO_2/min
Triticum aestivum L.	**Wheat kernel**	Palmitic acid, stearic acid, oleic acid, linoleic acid, linolenic acid	Moisturizing	200–350 bar, 40–60 °C, 15–25 L CO_2/h
Vitis vinifera L.	**Grape seed oil**	Oleic and linoleic acids and antioxidant-rich compounds	Moisturizing	28–550 bar, 40 °C
Daucus carrota L.	**Carrot fruit**	Carotol, geranyl acetate,β-caryophyllene, daucol, essential oil	Skin disorders, e.g. burns and furuncles	10 MPa, 40 °C
Borago officinalis L.	**Borage seed oil**	Free fatty acids: palmitic, stearic, oleic, linoleic acid, γ-linolenic acid	Skin wounds healing, moisturizing	200 and 300 bar, 40–60 °C, 0.20 kg CO_2/h
Oenothere biennis L.	**Evening primrose**	Γ-linolenic acid	Skin wounds healing, moisturizing	200 and 300 bar, 40 and 60 °C, 0.17 kg CO_2/h
Mangifera indica	**Mango leaves**	Phenolic compounds	Anti-aging activity	25 MPa, 45 °C, 1 h, 3.96 kg CO_2/s
Prinus dulcis	**Almond fruits**	Tochopherol, vegetable oil	Moisturizing	420 bar, 50 °C, 2–3 h, 30 kg CO_2,/h

Recent Projects

Pilot Scale Extraction System

- Research for Herbal products Extraction
- Capacity: 20L
- Pressure Rating: 650 bar
- Industry: Herbal Pharma Products
- Location: India

Production Scale Extraction System

- Essential Oil Extraction Plant
- Capacity: 300L
- Pressure Rating: 350 bar
- Industry: Essential Oil
- Location: Indonesia

Clients

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