CO_2-extracted blackcurrant seed oil for well-being of the skin

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Supercritical CO_2 extraction is a preferred method for production of bioactive lipophilic extracts from plants to be used as ingredients in nutraceuticals and cosmetics. Supercritical CO_2 at high pressure and low temperature has the capacity to penetrate and elute materials efficiently. The low temperature applied, and the absence of oxygen, ensures loss of no bioactivities. At the end of the extraction process, the CO_2 is released from the extract, producing a safe and solvent-free product without thermal stress. There is no need for refinement steps, which could affect the valuable bioactive compounds. In comparison to the other methods of commercial oil production – organic solvent extraction (hexane) and cold pressing – larger amounts of bioactive compounds have been reported in CO_2-extracted oils[1]. In fish oil production, the method was reported to be superior to the other methods in that it produces less oxidised oil, with reduced contaminant contents[2].

Aromtech Ltd (of Tornio, Finland) produces bioactive extracts from Northern plants by using supercritical CO_2 extraction. This gentle method produces berry oils with high antioxidant activity[3] and clinically proven beneficial effects[4–7]. Recently, the effects of CO_2-extracted blackcurrant seed oil for the skin were investigated in two clinical studies[8, 9].

The unique composition of blackcurrant seed oil

Blackcurrant (Ribes nigrum) berries are known for their high content of vitamin C and anthocyanins, which are enriched in the skin and soft parts of the berries[10]. In the Northern countries, blackcurrant juice is traditionally used for treatment and prevention of the common cold.

Seeds account for approximately five per cent of the fresh weight of blackcurrant berries. They are rich in oil that has a unique fatty acid composition. The main fatty acid is the essential fatty acid linoleic acid (LA, 18:2n-6), which makes up >40% of the fatty acids in the oil. The n-3 α-linolenic acid (ALA, 18:3n-3) accounts for 10–20%. Also, blackcurrant seed oil contains a large amount of γ-linolenic acid (GLA, 18:3n-6) and stearidonic acid (SDA, 18:4n-3), rare in food sources. The proportions of GLA and SDA

are 13–15% and 2–3% of total fatty acids, respectively (3, 11–13).

Atopic dermatitis and dietary fatty acids

Atopic dermatitis is a chronic skin disease characterised by dry, itching, and inflamed skin. The incidence of atopic dermatitis is increasing in the industrialised world. This has been associated with changes in the dietary intake of essential fatty acids[8].

In humans, the essential fatty acids can in enzyme-catalysed reactions be converted into fatty-acid derivatives of longer chain length in the same n-family of fatty acids. These, in turn, may act as precursors to eicosanoids, which locally regulate several important functions of the body, including inflammation. The n-3-fatty-acid-derived eicosanoids generally attenuate inflammation or have neutral effects. Although typically the effects of n-6-derived eicosanoids are considered pro-inflammatory, there are exceptions. Dihomo-γ-linolenic acid (DGLA, 20:3n-6), a derivative of GLA, is a precursor of anti-inflammatory prostaglandin E1[14].

The conversion of n-6 essential LA to GLA and n-3 ALA to SDA is catalysed by the enzyme Δ6-desaturase. Deficiency in the activity of Δ6-desaturase has been associated with several detrimental conditions, including atopic dermatitis[14–17]. The natural composition of blackcurrant seed oil, including the essential fatty acids LA and ALA in combination with their Δ6-desaturase derivatives GLA and SDA, makes it promising for human well-being.

CO_2-extracted blackcurrant seed oil for reducing the prevalence of atopic dermatitis in children

The effects of CO_2-extracted blackcurrant seed oil on atopic dermatitis in children were investigated in a double-blind, randomised, placebo-controlled study at the University of Turku, in Finland[8]. In total, 322 pregnant women were randomised for the study, half assigned to the blackcurrant seed oil group and half to the placebo group. In all, 177 mother-child pairs completed the trial.

The pregnant women consumed blackcurrant seed oil or a placebo daily from the 8th–16th week of pregnancy until the end of the exclusive breast-feeding period. After that, the infants were given a blackcurrant seed oil supplement or placebo oil until reaching the age of two years.

The blackcurrant seed oil used in the study was produced by Aromtech Ltd with supercritical CO_2 extraction. The placebo oil was olive oil. During pregnancy and lactation, the mothers consumed 3g of oil each day, in the form of six capsules. The daily dose of oil for the infants was 1 mL of liquid blackcurrant or olive oil. The prevalence and severity of atopic dermatitis in the children were evaluated at the ages of three months and one and two years. Severity was assessed by means of the SCORAD index.

At one year of age, the prevalence of atopic dermatitis was significantly ($p = 0.035$) lower in children in the blackcurrant seed oil group than in the olive oil group. The prevalence in the blackcurrant seed oil group was 33%, in contrast to the 47% in the olive oil group (see Figure 1). At two years of age, there was a trend of decrease in atopic dermatitis in the blackcurrant seed oil group ($p = 0.18$), but the difference between groups was no longer statistically significant. At two years, the prevalence figures for atopic

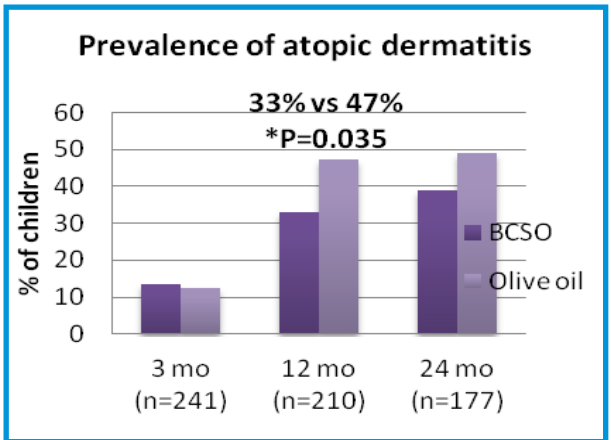

Figure 1. Prevalence of atopic dermatitis in the blackcurrant seed oil group (BCSO) and in the olive oil group at three points in time: children at three, 12 and 24 months of age. Adapted from the work of Linnamaa et al.[8].

dermatitis were 39% and 49% in the blackcurrant seed oil and olive oil group, respectively. Also, the symptoms of atopic dermatitis were less severe in the blackcurrant seed oil group in comparison to the olive oil group (significant at one year, $p = 0.035$; trend at two years, $p = 0.24$).

Atopic dermatitis is associated with inflammation, low activity of Δ6-desaturase, and

Supercritical CO_2-extraction at Aromtech Ltd in Tornio, Finland. Facility is registered for processing foods including organically certified materials

reduced levels of GLA in the serum. It is likely that the beneficial effects of blackcurrant seed oil were due to increases in GLA, DGLA, and DGLA-derived eicosanoids complemented with the anti-inflammatory potential of SDA and ALA[8].

Improvement in adults' skin hydration with CO_2-extracted blackcurrant seed oil

The effect of blackcurrant seed oil supplementation on skin hydration was investigated in a study of 40 healthy volunteers performed by the Finnish Cosmeticians' Association[9]. The participants were aged 36 to 61 years, and all except one were women. The study was an open one-group trial. During the intervention period of three months, the participants consumed 2 g of blackcurrant seed oil per day, in the form of four capsules. Again, the study oil was manufactured by Aromtech Ltd by means of supercritical CO_2 extraction.

The effects of blackcurrant seed oil on skin hydration were analysed with a bioimpedance device (Moisture-Meter D, from Delfin Technologies Ltd, of Kuopio, Finland) at the beginning of the study, at one month, and at the end of the intervention. The measurements were made on the cheek and the forearm. On the same occasions, the participants reported on parameters associated with the well-being of their skin, using a visual analogue scale (VAS).

During the intervention, the moisture content of the skin of the cheek and of the forearm increased significantly ($p < 0.05$). The participants also reported a significant reduction in the sensation of dryness and redness of the skin from the beginning of the intervention to the end.

It is possible that blackcurrant seed oil fatty acids affected the eicosanoid profile of the participants and, via this mechanism, induced the beneficial effects on skin well-being. Effects of the composition of skin ceramides may have manifested themselves as well. Linoleic acid, abundant in blackcurrant seed oil, is a component of skin ceramides. Ceramides are essential lipid components of the stratum corneum permeability barrier of the skin and therefore vital for normal hydration. Insufficient yield of polyunsaturated fatty acids causes increased transepidermal water loss[18].

From the recent clinical trials with CO_2-extracted blackcurrant seed oil, one can conclude that it has great potential in maintaining and supporting the well-being of the skin among both children and adults.

The CO_2-extracts are analyzed at Aromtech's laboratory. All procedures from raw material inspection to in-process material analyses to finished product quality are based on standardized analytical tehniques

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