

A review of clinical trials using Blackcurrants

1.0 How the review has been carried out

Blackcurrant extracts contain a range of antioxidant compounds, including anthocyanins, other polyphenolics and vitamin C which are reported to have a range of health benefits. The NZ Blackcurrant Coop Ltd (NZBC) has undertaken an independent review of some of these benefits to make more readily available the published scientific information on the health benefits of blackcurrants. This information is a collation and summary of this information and does not represent a claim by the NZBC with regard specific health benefits from the consumption of blackcurrants.

This review summarises eight clinical trials using blackcurrant extracts. The results reported here were obtained from randomised, double-blind, placebo-controlled, cross-over clinical trials published in peer reviewed journals. A treatment effect is only reported if it is statistically significant. Clinical trials represent a higher level of proof for an effect than either animal models or *in vitro* studies.

An overview of all the trials is presented in Section 2 and detailed summaries for the individual trials are in Section 3.

Berry equivalence

Several studies report amounts of blackcurrant extract ingested that were between 50-80 mg anthocyanin in about 500 mg powder. To put this in perspective this is equivalent to the anthocyanin in about 13 berries i.e. about a small handful.

This calculation is based on:

- There are a range of values for the anthocyanin content of NZ berries. However, 6mg anthocyanin /g fresh weight would be an average.
- A berry is about 1 g.
- Thus 13 berries contain about 78 mg.

Terms used

Placebo - a placebo is an inactive look-a-like.

Double blind - neither the individuals nor the researchers know who belongs to the control group and the experimental group.

In vitro - literally "in glass" and meaning in the laboratory.

Statistically significant - this means that there is a very low chance of the result having occurred randomly. For example; this may be shown by stating that the result is significant at the 1% level i.e. the chances of it happening randomly are 1 in 100. Alternatively a p value may be used e.g. $p < 0.008$ which means there is a 1 in 120 chance.

2.0 Summary of all eight trials

Three of the trials showed that extracts from blackcurrants and other berry fruit have been shown to increase blood flow with the following range of physical outcomes:

- Vasodilation of blood vessels
- Reduced muscle stiffening under repetitive work
- Reduced eye visual fatigue.

A fourth clinical trial used grape and berry extracts on fibromyalgia (chronic musculo skeletal pain). The outcomes were:

- Reduced fatigue
- Reduced sleep disturbance
- Increased general health.

All the above four trials indicate positive outcomes from increased blood flow to muscles and skin.

Another trial showed that increased intake of blackcurrant and orange juice decreased vascular inflammation, in patients with peripheral arterial disease, and the risk of cardiovascular disorder. After four weeks a daily drink of blackcurrant juice and orange juice gave an:

- 11% decrease in C-reactive protein
- 3% decrease fibrinogen.

Lower levels of both markers are considered desirable and indicate lower risk.

A 2009 New Zealand study looked at the effectiveness of blackcurrant powders containing high levels of anthocyanins to mitigate exercise induced stress. The study measured positive effects on:

- plasma oxidative stress parameters
- cytokines and other immune system regulatory factors.

The researchers concluded that blackcurrant extracts, taken at the appropriate time and amount, can augment the ability of regular exercise to enhance immune responsiveness of the body.

A positive effect on kidney function was shown in two trials.

The consumption of blackcurrant juice daily increased urinary pH, the excretion of citric acid and the excretion of oxalic acid. The researchers suggested that regular blackcurrant consumption could reduce the likelihood of kidney stone development as persistently low urinary pH is a significant factor for uric acid kidney stone formation.

In another study residents of a nursing home were given a daily glass of blackcurrant juice and reported reduced symptoms of urinary scalding, urgency and odour. Staff also noted improvements in white cell count on urinalysis and reduced likelihood of recurrent urinary tract infection. .

3.0 Summaries of individual trials

A summary of each trial is presented below. The published paper they are based on is referenced by the number in the heading.

Effects of blackcurrant intake on peripheral blood circulation during typing work (1)

This was a randomised double-blind, placebo-controlled, cross-over study. Study size was 10 people. Blackcurrant powder was prepared from liquid concentrate. The powder had an anthocyanin concentration of 10%.

There were two parts to the study 1) the effect of blackcurrants on peripheral circulation during rest, and 2) during typing work.

1. Blackcurrant effects during rest

- Subjects ingested 17 mg powder capsule/kg subject weight for the resting study
- What was measured:
 - Anthocyanin content in plasma
 - Forearm blood flow
 - Muscle oxygen consumption
 - Total hemoglobin and oxygenated hemoglobin
 - Electromyography of the right trapezius muscle.
- The results:
 - Anthocyanin content of plasma reached maximum after 1 hour, decreased to 50% by 4 hours.
 - Forearm blood flow increased significantly (about 40%) compared to placebo.
 - No effect on muscle oxygen consumption.

2. Blackcurrant effects during typing

- Subjects ingested 7.7 mg powder capsule/kg subject weight
- What was measured:
 - Total hemoglobin and oxygenated hemoglobin
 - Electromyography of the right trapezius muscle.
- The results:
 - Total hemoglobin was significantly higher (about 40%) in the blackcurrant intake group.
 - Oxygenated hemoglobin was significantly higher in the blackcurrant intake group.
 - Significant stiffening of the trapezius muscle during typing in the placebo but not the blackcurrant intake group. However, final stiffness not significantly different between the two.
 - No effect on blood pressure, heart rate, subjective pain and typing performance.

When the circulation is disturbed by compression of the blood vessels resulting from continuous muscle contraction removal of metabolites such as lactic acid becomes insufficient and leads to development of muscle stiffness. The study shows a vasodilatory¹ effect of blackcurrants.

Blackcurrants may reduce muscle stiffness by increasing peripheral blood flow and reducing muscle fatigue. Additional laboratory studies with animal models have shown direct effects of anthocyanins on improving blood peripheral circulation (not referenced below).

Effect of blackcurrants on dark adaptation and visual fatigue (2)

This was a randomised double-blind, placebo-controlled, cross-over study. Study size was 12. Subjects ingested up to 135, 270 and 540 mg blackcurrant powder for the dark adaptation test and 50 mg equivalent blackcurrant powder for the transient refractive alteration test.

- What was measured:
 - Dark adaptation threshold
 - Video display terminal (VDT) transient refractive alteration
 - Visual fatigue (asthenopia)

- The results
 - Dark adaptation was significantly improved at the highest level of 540 mg blackcurrant powder (50 mg anthocyanin);
 - There were no significant effects on VDT transient refractive alteration;
 - Visual fatigue was significantly reduced with blackcurrant treatment;
 - Lower back fatigue was significantly reduced with blackcurrant treatment.

The effects are considered to be mediated by increased blood flow in the peripheral circulation.

Effect of blackcurrants on blood flow (3)

This was a randomised double-blind, placebo-controlled, cross-over study using nine female subjects (age 22 to 34). The subjects had daily subjective symptoms of chill, and used 50mg blackcurrant anthocyanin.

After soaking the right hand in cold water of 10 degrees centigrade for one minute, images were taken of the hand using thermography and blood flow volume measured every minute (up to 30 minutes) until the hand returned to resting level. Body temperature did not return to normal after 15 minutes without blackcurrant consumption. In contrast, however, body temperature began to return to normal 10 minutes after blackcurrant consumption.

Effect of anthocyanins on fibromyalgia (4)

Fibromyalgia is a condition of chronic widespread musculo-skeletal pain, particularly in the neck and shoulders, knees and elbows, and lower back.

¹ Vasodilation refers to the widening of blood vessels resulting from relaxation of smooth muscle cells within the vessel walls. When vessels dilate, the flow of blood is increased due to a decrease in vascular resistance. Therefore, dilation of arterial blood vessels (mainly arterioles) leads to a decrease in blood pressure.

This was a randomised double-blind, placebo-controlled, cross-over study of four treatment periods of 12 weeks each. Study size was 10. Subjects ingested 40, 80 or 120 mg anthocyanin per day, from a proprietary product based on extracts of grape seeds, and berries.

- What was measured:
 - Severity of pain symptoms
 - Fatigue and sleep disturbance
 - Patients assessment of treatment
 - General health questionnaire.

- The results:
 - There was a very significant effect (at 1% level) on reduction in sleep disturbance, as assessed by subject's diary record.
 - There was a significant improvement in the general health questionnaire.
 - There was a significant improvement in the severity of fatigue (at 1% level) as assessed by the investigator.
 - The best treatment was 80 mg/day.

The authors concluded that anthocyanins were beneficial for people suffering from this difficult chronic condition.

Effects of blackcurrant juice and orange juice on markers of vascular inflammation and cardiovascular risk (5)

Vascular inflammation is an important contributing factor to cardiovascular disorder. This study looked at the effects of blackcurrant and orange juices on markers (indicators) of vascular inflammation in patients with peripheral arterial disease. The markers were C-reactive protein and fibrinogen. Lower levels of both markers are considered desirable and indicate lower risk.

This was a randomised double-blind, placebo-controlled, cross-over study of four weeks duration. Study size was 48. Subjects drank 250 mls of blackcurrant juice and 250 mls of orange juice daily. A sugar drink placebo was used.

At the completion of the study, there were statistically highly significant decreases in the levels of each of C-reactive protein and fibrinogen. There was an 11% decrease in C-reactive protein, ($p < 0.008$); and a 3% decrease in fibrinogen ($p < 0.002$).

The study supports the view that increased intake of fruit products such as blackcurrant and orange juice decreases the risk of cardiovascular disorder.

Effects of blackcurrant powder on exercise-induced oxidative stress (6)

Exercise induces oxidative stress in the body. Dietary antioxidant supplements and foods are commonly used to limit such stress after exercise. This study looked at the effectiveness of blackcurrant powders containing high levels of anthocyanins to mitigate exercise induced stress. This was a double blind placebo controlled cross over study of three weeks duration. Study size was 10 healthy subjects who exercised regularly about three times a week. Subjects consumed

four capsules (two pre and two post exercise) equivalent in total to about 48 g whole blackcurrants (this corresponds to about 1/3 cup berries). A sugar placebo was used.

- What was measured:
 - Three plasma oxidative stress parameters
 - Effects on cytokines and other immune system regulatory factors, as measured in a laboratory assay of inflammatory response generated by bacterial endotoxins.
- The results:
 - Blackcurrant powder reduced exercise induced oxidative stress as shown by significantly lower levels of protein carbonyls, oxidative capability, and creatine kinase activity ($p < 0.05$)
 - After exercise blood samples, from the subjects fed blackcurrant powder, showed a significant ($p < 0.05$) ability to suppress inflammatory responses as measured by cytokines and other regulatory factors in the above laboratory assay.

The researchers concluded that blackcurrant extracts taken at the appropriate time and amount, can augment the ability of regular exercise to enhance the immune responsiveness of the body.

Effects of blackcurrant on kidney function (7, 8)

The consumption of 330 ml blackcurrant juice daily for five days increased the

- urinary pH
- excretion of citric acid
- excretion of oxalic acid.

It is suggested that regular blackcurrant consumption could reduce the likelihood of kidney stone development as persistently low urinary pH is a significant factor for uric acid kidney stone formation.

In another study residents of a nursing home were given a daily glass of blackcurrant juice for 3 months. Residents reported reduced symptoms of urinary scalding, urgency and odour. Staff noted improvements in white cell count on urinalysis and reduced likelihood of recurrent urinary tract infection over a three month period.

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