Formula Aim: To aid healing after trauma from injury or surgery by supporting healing, recovery and protection from the side effects of anaesthesia.

The basic healing and support process, with the herbs that can assist are:

- cleaning up of debris by immune cells; infection can slow this down (Echinacea, Black Currant)
- establishing new blood vessels (Gotu Kola, Black Currant)
- regenerating connective tissue elements (Gotu Kola, Black Currant, Echinacea)
- regenerating epithelial cells (Gotu Kola, Black Currant)
- supporting and protecting the liver from the effects of general anaesthesia (Milk Thistle)

Gotu Kola Herb (*Centella asiatica*)

Gotu Kola has been chosen for its proven ability to ensure efficient regeneration and repair. In post operative and post trauma management the production of new connective tissue and the reduction of scar tissue are important issues. Gotu Kola stands out in this area.

Interestingly, Gotu Kola can not only can be used topically but can also be taken internally to encourage healing. There are many herbs that are effective topically, but relatively few that can promote healing following ingestion. The significance of this is that it suggests that the healing potential of Gotu Kola is not just confined to the skin, and can be used to promote healing in any tissue ie; skin, bones etc.

Positive results were obtained for oral use of Gotu Kola taken for three to eight weeks in 50 patients with leg ulcers (Huriez, 1972). In 1996 Suguna et al., showed oral and topical administration of Gotu Kola extract produced faster skin growth and higher rates of wound contraction compared to controls.

Oral administration of Gotu Kola has been used successfully to treat keloids and hypertrophic scars. In a study of 227 patients Bosse et al., 1979, found treatment with Gotu Kola for a period of two to 18 months had therapeutic value in both preventing and reducing keloids (excessive scar formation on the skin).

The area where Gotu Kola excels is in wound healing, through promoting efficient regeneration and repair via its ability to stimulate the activity of fibroblasts (including osteoblasts) and epithelial cells. Gotu Kola has several clinical trials supporting its ability to boost healing even where other treatments failed. (Chakrabarty & Deshmukh 1976, Nebout 1974).

For efficient healing it is vital to have a good blood supply to the area. Gotu Kola helps strengthen veins and capillaries (Cesarone et al. 2001). Clinical trials have established that Gotu Kola improves microcirculation along with production of connective tissue, and overall wound healing (Belcaro et al 1989; Grimaldi et al., 1990; Tincani et al., 1963; Arpaia et al., 1990). Some studies have shown that it actually speeds up the healing process, especially in the production and strengthening of connective tissue (Vogel et al.,1990; Suguna et al., 1996).
These effects have been noted after various surgical procedures (Castellani et al., 1966; Sevin, 1962) and other traumatic injuries (Stassen 1964). Some clinical trials have also found that Gotu Kola helps correct and prevent the formation of scars. (Bosse et al., 1979).

Widgerow et al., 2000, found collagen synthesis was a mechanism of action. Through stimulation of scar maturation by the production of Type I collagen and a resulting decrease in the inflammatory reaction.

Poizot & Dumez, 1978 found Gotu Kola acted specifically to shorten the immediate phase of healing, probably due to the increased glycosaminoglycan production. Then Maquart, et al., 1999 found Gotu Kola stimulated glycosaminoglycan production (glycosaminoglycans are the first component of the extracellular matrix to be synthesized during the wound healing process). Glycosaminoglycans (GAGs) include hyaluronic acid, a component in the synovial fluid lubricant in body joints; chondroitin 4- and 6-sulfates which can be found in connective tissues, cartilage, and tendons; keratan sulfate found in joints and act as a cushion to absorb mechanical shock; dermatan sulfate which is believed to play a role in wound repair.

References:

Milk Thistle Seed (Silybum marianum).

Milk Thistle has been included in this formulation mainly for its antihepatotoxic, hepatoprotective and hepatoregenerative properties. Milk Thistle improves liver function in incidences of toxic poisoning, reduces the side effects of some pharmaceutical drugs and helps repair liver damage. Supported by its bitter principle to encourage appetite and the antibacterial activity to support infection control.

Since 1969, widespread ongoing scientific research has shown conclusively that the flavonolignan constituent silymarin which consists of silybin, silydianin and silychristin in Milk Thistle is a potent
hepatoprotective substance that can reverse the effects of toxic damage as well as heal liver cells.

Milk Thistle has several therapeutic uses with its predominant role in the treatment of liver disease. It is also used in conditions where the liver is placed under stress from the use of hepatotoxic medication or exposure to toxins. As Milk Thistle reduces liver damage from chemotherapy and accelerates the recovery from its side-effects, it is now used as an adjunct to cancer treatment. (Keville 1991, Nice 2000, Weiss et al 2000)

Silymarin prevents liver damage through its strong antioxidant activity, by scavenging for free radicals and neutralizing toxic invaders. It also promotes the release of superoxide dismutase, a powerful antioxidant. (Chevallier 2001, Nice 2000, Weiss et al 2000)

Silymarin also stabilizes the lipid structures in the hepatocellular membrane, enhancing the outer membrane’s ability to prevent toxins from entering liver cells. Studies have found that silybin promotes the synthesis of ribosomal ribonucleic acids by stimulating nucleolar polymerase I. This reinforces protein synthesis in the liver cells, enhancing regeneration processes. Severe liver damage, resulting from the ingestion of carbon tetrachloride or death cap mushrooms (*Amanita phalloides*) can be prevented if silymarin is taken immediately. (Czygan et al 1994, Keville 1991, Mills 1991, Weiss et al 2000)

The bitter principle in Milk Thistle is effective in stimulating bitter taste receptors on the taste buds, which fuel the release of the gastrointestinal hormone, gastrin, which in turn stimulates appetite. Bitters also increase digestive secretions, protect gut tissues, promote bile flow and enhance pancreatic functions. (Mills 1991, Weiss et al 2000)

The polyacetylenes in Milk Thistle possess antibacterial and antifungal activity. (Mills 1991)

References


Blackcurrant Fruit (*Ribes nigrum*)

Blackcurrant has been chosen for its high levels of anthocyanidins and Vitamin C. More specifically for its anti-inflammatory, antioxidant and tissue trophorestorative activity.

The berries are rich in polyphenolic compounds and especially in anthocyanins, demonstrating antioxidant activity. Antioxidant activities of plant products contribute multiple health benefits.

Blackcurrants are high in biotin, a key component of the claw and hoof wall. Although the dietary requirements for biotin in dogs and horses are not well defined, the responses to biotin supplementation to improve hoof quality are quite significant. (E. A. Buffa et al., 1992, H. Josseck et al., 1995) After 5 months of supplementation hoof condition of all 55 of a group of thoroughbreds and draft horses showed marked improvement. (Comben et al., 1984)

Although traditionally Bilberry was considered the best source of anthocyanins which give the berries their deep purple colouring and have extremely high antioxidant activity. Bilberry is not grown in NZ on a commercial scale so must be sourced from Europe or USA. However recent trials by the New Zealand Institute for Plant and Food Research on NZ grown Blackcurrant have shown it
to be equal to even the best bilberries for anthocyanin levels.

**Figure 1. Typical Anthocyanin levels in common fruit (unit: mg/100g)**

<table>
<thead>
<tr>
<th>Fruit</th>
<th>mg Anthocyan/100g fresh product</th>
<th>Major Anthocyanidin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raspberry <em>Rubus idaeus</em></td>
<td>40</td>
<td>Cyanidin</td>
</tr>
<tr>
<td>Blackberry <em>Rubus caesius</em></td>
<td>160</td>
<td>Cyanidin</td>
</tr>
<tr>
<td>Bilberry <em>Vaccinium myrtillus</em></td>
<td>165</td>
<td>Delphinidin, Malvidin, Petunidin</td>
</tr>
<tr>
<td>Black Currant <em>Ribes nigrum</em></td>
<td>270</td>
<td>Cyanidin, Delphinidin</td>
</tr>
</tbody>
</table>

The fruit is also extraordinarily high vitamin C content at 160mg/100 g

**Figure 2. Typical Vitamin C levels in common fruit (unit: mg/100g)**

<table>
<thead>
<tr>
<th>Fruit</th>
<th>mg/100g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackcurrant</td>
<td>160</td>
</tr>
<tr>
<td>Kiwifruit</td>
<td>93</td>
</tr>
<tr>
<td>Orange</td>
<td>36</td>
</tr>
<tr>
<td>Cranberry</td>
<td>13</td>
</tr>
<tr>
<td>Blueberry</td>
<td>10</td>
</tr>
<tr>
<td>Bilberry</td>
<td>1</td>
</tr>
</tbody>
</table>

(http://www.nzblackcurrants.com).

**Summary of three trials carried out by the New Zealand Black Currant Cooperative.**

**Anthocyanins increase bloodflow.**

In a human trial subjects consumed anthocyanin (100mg) equivalent to two tablespoons of blackcurrant berries.
- Anthocyanin content of plasma reached a maximum after 1 hour, and decreased to 50% by 4 hours.
- After 1 hour the forearm blood flow increased significantly (about 40%) compared to placebo.

In another study 50mg of anthocyanin was shown to improve blood circulation in cold hands.
- Hands were soaked in cold water at 10°C for 1 minute. For subjects who had consumed blackcurrants hand temperature returned to normal after 7 minutes, compared to 13 minutes for the placebo group.
Blackcurrants reduce muscle stiffness by increasing peripheral blood flow and reducing muscle fatigue.

- Subjects consumed anthocyanin (50mg) equivalent to one tablespoon of blackcurrant berries and carried out keyboard work for 30 minutes.
- Total haemoglobin was significantly higher (about 40%) in the blackcurrant intake group. Oxygenated haemoglobin was significantly higher in the blackcurrant intake group.
- There was significant stiffening of the trapezius (shoulder) muscle during typing in the placebo but not the blackcurrant intake group. However, final stiffness was not significantly different between the two.

(http://www.nzblackcurrants.com)

The Importance of Anthocyanidins

In the course of inflammation, enzymes damage connective tissue in capillaries, causing blood to leak into surrounding tissues. Oxidants are released and further damage blood-vessel walls.

Anthocyanins protect in several ways.
- First, they neutralize enzymes that destroy connective tissue.
- Second, their antioxidant capacity prevents oxidants from damaging connective tissue.
- Finally, they repair damaged proteins in the blood-vessel walls.

Studies to support use

Animal experiments have shown that supplementation with anthocyanins effectively prevents inflammation and subsequent blood-vessel damage (Bertuglia S. et al., 1995).

Anthocyanins anti-inflammatory ability has been shown to help dampen allergic reactions. In one study, Bulgarian researchers gave animals histamine and serotonin, both of which cause allergic reactions and increase capillary permeability. The animals were supplemented with a variety of flavonoids. Anthocyanins were found to have the strongest anti-inflammatory effect of any flavonoid tested (Borissova P, et al. 1994).

Dietary polyphenols have been found to inhibit cellular enzymes, such as PLA2, COX and LOX, in order to reduce arachidonic acid, prostaglandins and leukotrienes production, thus exerting an important anti-inflammatory action (Yoon JH, et al., 2005, Baumann J, et al., 1980, Welton AF, et al.,1986, Laughton MJ, et al.,1991, A viram et al., 1998).

Some study results suggest that polyphenols inhibit NO release by suppressing NOS enzymes expression and/or NOS activity (Kim HP, et al., 2004, Sutherland BA, et al., 2006).

Cyanidin-3-glucoside (Cy3G) induced eNOS expression and escalated NO production (Xu JW, et al., 2004). Increased eNOS expression may help to ameliorate endothelial dysfunction giving a long-term beneficial effect of supplementation.

Anthocyanins in the fruit have demonstrated in laboratory experiments a potential to inhibit inflammation mechanisms (Heinonen, M. 2007, Seeram, NP. (2008)

Vitamin C

Vitamin C (L-ascorbic acid) is found in rose hips, blackcurrants, and citrus fruits but can also be synthesised from glucose. It is an antioxidant, since it protects the body against oxidative stress. (Padayatty, et al., 2003) It is also a cofactor in several collagen synthesis reactions that cause the most severe symptoms of scurvy when they are dysfunctional (Vitamin C 2007). Collagen is found
throughout the body. It is an important component of connective tissues, tendons, ligaments, cartilage, bone and blood vessels.

**The Importance of Vitamin C**

Collagen synthesis reactions are especially important in wound-healing and in preventing bleeding from capillaries. Vitamin C is essential to the development and maintenance of scar tissue, blood vessels, and cartilage (MedlinePlus Encyclopaedia Ascorbic acid).


There is some debate as to the necessity for Vitamin C supplementation as dogs produce their own vitamin C unlike humans and guinea pigs who must have it in their diet. It is therefore thought Vitamin C supplementation is unnecessary, but is believed will do no harm as the excess is excreted. Under conditions of stress, disease, surgery or injury the requirement for vitamin C may exceed the capacity for synthesis.

If supplementation is required then some believe they will get enough for their needs from a balanced diet. Although many dogs are perceived to be fed a balanced diet they are not receiving the raw diet they would be eating in the wild, most meat is cooked or heated which destroys the Vitamin C. There therefore may be a real need for supplementation.

Recommended moderate doses of Vitamin C are approximately 250 mg to 500mg twice daily for the average dog.

**Studies to support use**

Ascorbate has been demonstrated to be an effective antioxidant. This review presents evidence which supports the importance of vitamin C as a component of the overall antioxidant protective mechanisms found in cells and tissues. The data are consistent and form a strong consensus for investigating the importance of the antioxidant function of vitamin C in the maintenance of human health. (Bendich A, et al., 1986)

Vitamin C deficiency is detrimental to immune function, resulting in reduced resistance to some pathogens. Routine supplementation is not indicated in the general population, though there is some evidence that it reduces symptom severity but not incidence of the common cold. Effects are most pronounced in cases of physical strain or insufficient dietary intake. (Hemilä, et al., 2007, Ströhle A, et al., February 2009).


A study where a group of guinea pigs were feed on supplemented levels of vitamin C or minimal diet group after surgically inducing osteoarthritis in a joint. Early stages of pathology in both diet groups were characterized by formation of repair cartilage. As the disease progressed, pitting, ulcerations, and eburnation occurred in the minimal diet group. Cartilage weight in normal joints was greater for guinea pigs kept on high levels of vitamin C. It is likely that this stimulated synthesis of cartilage in the supplemented animals protected against the erosion of the articular cartilage which characterized the more severe disease process in the guinea pigs on minimal levels of vitamin C. (Schwartz ER. et al.,1981)
References


Echinacea Root (*Echinacea purpurea*)

Echinacea is an excellent herb to add to this formulation as it has the ability to promote wound healing through the prevention of possible infection by enhancing the non specific immune system; cytokines, lymphocytes and phagocytosis. Echinacea also inhibits the breakdown of hyaluronic acid by the enzyme hyaluronidase and has been shown to promote tissue regeneration by stimulating fibroblasts.

Coeugniet 1987, Bauer 1996 found the reputed immune-enhancing effects of Echinacea are thought to be mainly directed toward non specific immune mechanisms including phagocytic activity, macrophage activation, and NK cell activity. These effects have been demonstrated for alcoholic extracts of the roots of *E. purpurea*. Several trials have shown that the most potent immunostimulation occurs with the ethanolic preparations.

Research by Miller 2005 highlighted the effects of Echinacea in supporting the nonspecific arm of the immune response, which is most important for healing. Yaodi et al., 2008 confirmed that *Echinacea purpurea* had obvious immunological enhancement.

Studies have demonstrated that the alkylamides and caffeic acid derivatives strongly activate the monocyte-phagocyte system. By activating this portion of the immune system, immune surveillance is enhanced and resistance to infection is increased.

Sullivan et al., 2008, demonstrated *Echinacea purpurea* extract activated the innate immune response, stimulating production of IL-6, TNF, IL-12, and NO from macrophages in vitro. Along with evidence of enhanced macrophage function. Steinmuller et al., 1991 found that oral Echinacea reduced bacterial burden during infection by Listeria monocytogenes, demonstrating its efficacy in vivo.

Echinacea has good coverage against Staphylococcus and Streptococcus, both of which can cause infections in open wounds. Echininosid and caffeic acid possess antibacterial activity against *Staphylococcus aureus*, *Corynebacterium diphtheria*, and *Proteus vulgaris*. *Staphylococcus aureus* is a major cause of wound infections. The polyacetylenes in Echinacea are effective against Streptococcus infections and have also been found to have anti-fungal properties.

The polysaccharide fraction of Echinacea has been shown to bind to the T-lymphocyte surface receptor in a way which stimulates the production of interferon and other immune modulators. It appears that the immune-stimulating effects of Echinacea result from polysaccharides surrounding tissue cells and thereby providing protection from bacterial and pathogenic invasion (Newall, et al., 1996).

Sasagawa et al., 2006 has shown Echinacea to inhibit the breakdown of hyaluronic acid by the enzyme hyaluronidase. Hyaluronic acid is a mucopolysaccharide which fills the intercellular spaces of the body and acts as "cement" to hold cells together. Hyaluronidase causes the "cement" or connective tissue to become "leaky" allowing the organism of infection greater access to the body and bloodstream. Through the inhibition of this enzyme, Echinacea helps the connective tissue retain its integrity and keep the infection localized.

In addition to the stabilization of hyaluronic acid, the polysaccharide components of Echinacea have been shown to promote tissue regeneration by stimulating fibroblasts (Enbergs & Woestmann, 1986). Fibroblasts manufacture ground substance found within connective tissue and are abundant in the tendons of muscles and the ligaments of joints. Stimulation of these fibroblasts may enhance healing of soft tissue injuries.

Over a number of years Crop & Food Research in Otago, New Zealand has done work on the distribution of alkamides in Echinacea and have shown that the highest concentrations are in the roots. Interestingly the market prices for raw herbs also reflect this.
References