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Anticancer effects of Echinacea

Echinacea is one of the most popular herbal medicines taken by cancer patients in many countries[1], this being largely related to its reputation as an immunostimulant and evidence that it can induce a functional increase in natural killer cell activity[2,3].

Chronic administration of Echinacea to mice with leukaemia has been associated with increased survival rates in three separate studies[4,5,6]. Prolongation of the life expectancy of normal mice who were fed a daily dose of 2mg of dried *Echinacea purpurea* root from seven weeks of age until 13 months of age, has also been shown by Canadian researchers[7].

This prolongation of natural longevity, in which 74% of the Echinacea treated mice were still alive at 13 months of age, compared to only 46% of untreated mice, was accompanied by increased natural killer cell activity, and related by the authors to a reduced development of spontaneous tumours during daily Echinacea treatment[7]. Development of tumours is well known to increase in frequency in both mice and humans during progressing aging, due to deterioration in natural immune surveillance mechanisms.

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Despite these highly interesting findings, the direct effects of Echinacea on human cancer cells have been poorly investigated until recently. Only one study reporting *in vitro* inhibition of tumour cells by lipophilic fractions of *Echinacea pallida* roots and the essential oil of *Echinacea angustifolia* root, has previously been reported[8].

Italian researchers have recently investigated the potential *in vitro* cytotoxic and pro-apoptotic (cell death promoting) effects of the three main medicinal species of Echinacea, using human pancreatic cancer (MIA PaCa-2) and colon cancer (COL0320) cell lines[9]. Extracts of the dried roots of three year old *Echinacea angustifolia*, *Echinacea purpurea* and *Echinacea pallida* were each prepared using n-hexane as a solvent. The resulting extracts were not phytochemically characterised, although this solvent is known to optimise extraction of non-polar or lipophilic constituents such as alkylamides (alkamides) and polyacetylenes, as opposed to polar constituents such as polysaccharides or caffeic acid derivatives such as cynarin and chicoric acid.

Three different assays were used to assess possible anti-cancer activities. A cell viability assay, in which extracts of Echinacea roots in concentrations of 1-300µg/ml were incubated with both cancer cell lines for 72 hours, was used to calculate the concentration required to inhibit 50% of cell growth (IC50). Effects of *Echinacea pallida* extract on the activity of caspase 3 and 7, enzymes which play a key role in the induction and execution of apoptosis, as well as its ability to cause DNA fragmentation in the cancer cells, were also measured.

A significant reduction in the viability of both tumour cell lines was measured for all three Echinacea species, in a concentration-dependent manner. These effects were most pronounced on the colorectal cancer cell lines, *Echinacea pallida* exhibiting the strongest effect with an IC50 of 10.55µg/ml. Enhancement of caspase 3 and 7 activities, an effect paralleled by increased production of DNA fragments, was also measured following treatment with *Echinacea pallida* extract in higher concentrations of 50-100µg/ml.

The greater activity shown by *Echinacea pallida* than other species in these studies, suggests a possible contribution of polyacetylene compounds to these anti-cancer effects. These somewhat unstable compounds are found in much greater levels in *Echinacea pallida* than other Echinacea species, and cytotoxic effects of several polyacetylenes against various types of human cancer cell lines have previously been reported[10,11,12,13,14,15,16]. A possible contribution of Echinacea alkylamides to help protect against cancer, is also discussed by the authors.

The issue of Echinacea as adjunctive therapy during chemotherapy treatment for cancer, has also been investigated recently by an American study[17]. The authors noted an earlier report that *Echinacea purpurea* extracts protected non-cancerous cells from apoptosis[18], and postulated that it could therefore prevent apoptosis of cancer cells as well. They therefore conducted an *in vitro* study to determine the effects of *Echinacea angustifolia* root extracts and individual Echinacea constituents on cervical and breast cancer cell lines (HeLa and MCF-7 respectively), treated also with the cytotoxic drug doxorubicin.

While incubation with one of the various Echinacea root extracts used prior to doxorubicin addition produced a 35-70% increase in HeLa cancer cell growth, and the ethyl acetate fraction and cynarin increased cell growth of MCF-7 cells, these effects were not dose dependent. It is also unclear from their results what actual concentrations of Echinacea produced these effects, and whether these reflect those likely to be achieved *in vivo* following oral administration. Of note also was that several of the nonpolar fractions showed antiproliferative activity, and cynarin seemed to enhance the cytotoxic activity of doxorubicin on MCF-7 cells.

Adverse interactions between Echinacea and chemotherapy therefore remain unproven by the results of this latter study. The unknown contribution of factors such as the different phytochemical makeup of each Echinacea extract tested, pharmacokinetic parameters for each constituent in a clinical setting, and failure to measure a dose response relationship, throw their likely significance into doubt.

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Beneficial effects of wormwood in Crohn's disease

Wormwood (*Artemisia absinthium*) is a well known shrub native to central Europe and Asia, whose popularity as a medicine pre-dates the earliest written herbal texts. It was also a key ingredient of the spirit drink known as absinthe, whose regular heavy consumption was observed to cause the syndrome known as absinthism, in which an initial stimulant effect was followed by hallucinations then a depressive phase. As a result of this and mass consumption of the beverage in the early twentieth century when moves were afoot to prohibit alcohol in general, absinthe was subsequently banned from use in most countries. These restrictions have however now been lifted as a result of evidence that levels of the potentially toxic volatile oil constituent thujone were previously grossly overestimated[1, 2].

Wormwood was of course once widely used throughout the world as a preventive measure for helminthiasis (gastric parasitic worm infection) and fevers [3, 4], as well as an antimicrobial agent and for digestive conditions in general. Its activity as a powerful bitter tonic is well known, and Culpeper described weak infusions as being excellent in all disorders of the stomach and liver. Amongst practitioners today it is mainly used to stimulate the appetite, digestive juice secretions, and liver and gallbladder function.

These properties have been somewhat validated through research showing anthelmintic, antiparasitic, antibacterial, antimicrobial, anti-inflammatory and hepatoprotective activities for the herb or its essential oil [3,4,5,6,7,8].

Clinical trial

The aetiology and pathogenesis of Crohn's disease is poorly understood, although a possible contribution of infection with a primary bacterial or viral pathogen has been suggested. Possible candidates include the animal livestock virus Mycobacterium avium subspecies paratuberculosis virus[9, 10,11], as well as cytomegalovirus, herpes or Epstein-Barr viruses[12,13,14,15,16].

Based upon the above and unpublished work which found *in vitro* protective effects of aqueous extracts of wormwood against the herpes virus, researchers from Germany and the USA hypothesised that wormwood might have a useful role as part of the treatment of Crohns Disease[17].

A multicentre clinical trial was subsequently conducted in which wormwood capsules were added to standard drug treatment in a group of forty patients diagnosed with Crohn's disease at least three months previously. All patients were also being treated with stable doses of 5-aminosalicylates and corticosteroids, and in some cases the immunosuppressants azathioprine or methotrexate[17].

The active treatment group took a dose of two capsules three times daily for a period of ten weeks, each containing 250mg wormwood powder as well as 100mg of rose, 40mg of cardamom and 10mg of mastic resin. The placebo capsules used contained the non-wormwood ingredients only. The wormwood preparation used contained 0.37% absinthin and less than 5 parts per million of thujone.

Remission and response rates were measured according to the Crohn's Disease Activity Index. Secondary effects on health-related qualities of life were assessed through a questionnaire involving disease symptoms and any impact on the social and emotional lives of the patients, as well as the Hamilton depression rating scale.

The dose of corticosteroids being taken by the patients at the start of the trial was maintained until the second week, after which a tapering schedule began. By week ten all corticosteroids had been ceased, although aminosalicylates and other drugs were maintained at the same dosages. Wormwood or placebo treatment was then discontinued at week ten, but standard drug treatment continued for a further ten weeks.

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Of the twenty patients in the placebo group, sixteen (80%) experienced a worsening of Crohn's disease symptoms due to the reduction in steroid dose, while only two (10%) of patients in the wormwood-treated group experienced the same. Steroids needed to be recommenced in eleven patients in the placebo group, but in only two from the wormwood group. At week ten, thirteen patients (65%) of the treatment group were almost free of Crohn's disease symptoms and did not need to restart steroid treatment in the ensuing follow-up ten weeks.

This remission occurred despite discontinuation of both steroid and wormwood, suggesting long-lasting benefits from wormwood treatment. Clinical improvement was observed in a statistically greater number of patients in the treatment as opposed to placebo group after only 6 weeks of treatment.

While virtually no change was reported in subjective feelings of illness by patients in the placebo group, significant improvement was indicated from these evaluations in the wormwood group. Hamilton depression rating scores also fell by an average of 9.8 in the wormwood group but by only 3.4 in the placebo group.

This trial provides encouraging results suggesting that wormwood at a dose of 500mg three times daily could be a very useful treatment in Crohn's disease patients, and enable a lessening in dosage requirements or avoidance of the need for steroid therapy in a large proportion of cases. Such beneficial effects include not only improvement in conventional disease rating scales, but also a lessening in secondary related symptoms such as depression or a poor quality of life experienced by some patients. While the authors link these beneficial effects with the anti-viral properties of this herb, its anti-inflammatory, immunomodulatory and various other actions on the gastrointestinal system, could also be contributory.

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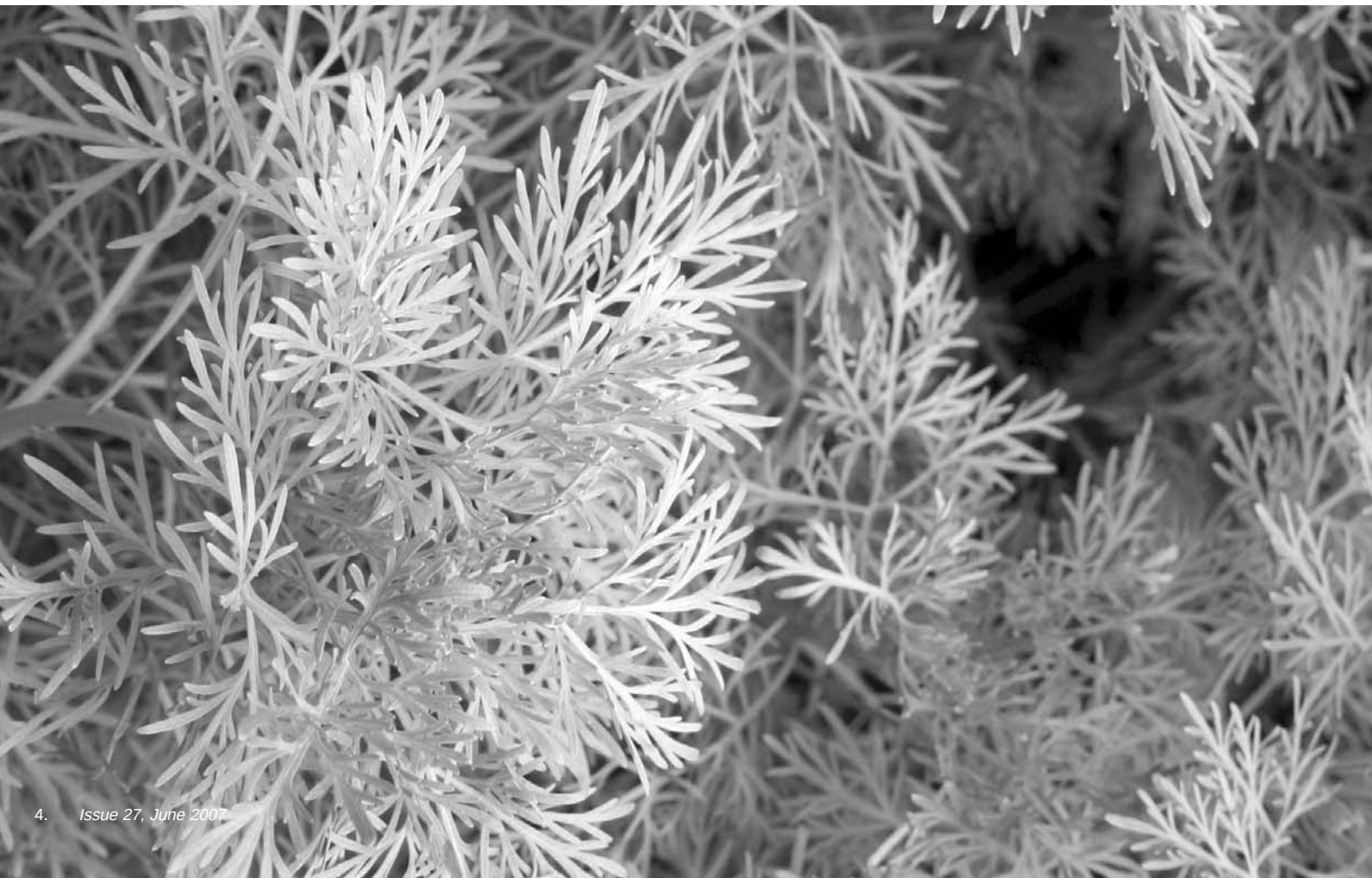

Ginger interaction with cyclosporine?

Phytomedicines known as 'circulatory stimulants', such as chillis, ginger and pepper, are often claimed to increase the blood flow to the digestive tract, and thus enhance gastrointestinal absorption of other substances. Concurrent use of these warming spices is a popular method used by some practitioners to allegedly improve the therapeutic effects of other orally administered herbal or drug medicines.

Such usage was encouraged following suggestions that *Trikatu*, an Ayurvedic preparation containing equal parts of black pepper (*Piper nigrum*), long pepper (*Piper longum*) and ginger (*Zingiber officinale*), could enhance the absorption of other medicaments[1]. In fact, this preparation is widely prescribed together with other medicines in India, with the aim of enhancing their bioavailability. Increased absorption of the plant alkaloids vasicine and sparteine[2], curcumin[3], and the drugs propranolol, theophylline[4] and phenytoin[5], has also been reported during concurrent administration of *Piper longum* and or its active alkaloid compound piperine[2].

Several studies undertaken in recent years however, have challenged these presumed effects for other substances. *Trikatu* for example, has been shown to cause a significant delay in bioavailability of the anti-tuberculosis drug rifampicin in rabbits[6], and reduced rather than increased absorption of the non-steroidal anti-inflammatory drug diclofenac, has also been reported in rabbits[7]. Bioavailability of salicylic acid following both acute and chronic oral aspirin administration, was also reduced when chilli pepper (*Capsicum annuum*) was given to rats[8].

Such interactions involving phytomedicine-induced increased or reduced absorption of drugs from the gastrointestinal tract, are much more likely to be significant for drugs which have a narrow therapeutic margin. This includes the immunosuppressant drug cyclosporine, whose plasma levels need to be kept within a fairly narrow range to ensure efficacy and minimise adverse effects.

A recent study which investigated the effects of ginger juice on the pharmacokinetics of cyclosporine in rats, suggests such an interaction[9]. Rats were given oral cyclosporine in combination with ginger juice at a dose of 5ml per kilogram (equivalent to 30ml in a 60kg human), either concomitantly or two hours before the drug dosing. Subsequent measurement of cyclosporine blood levels found that maximum levels (Cmax) of cyclosporine were reduced by 70.9%, and the Area Under the plasma levels versus time Curve (AUC), by 63.1%, when ginger was given at the same time as cyclosporine. Giving ginger two hours prior to drug administration, resulted in a lesser but still significant reduction in these parameters of 51.4% and 40.3%, respectively. As the pharmacokinetics of intravenous administration of cyclosporine was unaltered by oral ginger administration, this interaction appears to involve reduced oral drug absorption as a result of ginger.

The likely clinical significance of such findings to use of ginger in patients taking cyclosporine remains unknown, as results from such large single dose studies in animals can vary from multi-dose studies in humans. Nevertheless, this study implicates the possibility of a potentially serious interaction between ginger and cyclosporine, which is often taken long term as an anti-rejection drug following organ transplants, or for serious autoimmune conditions. Human studies are therefore needed.

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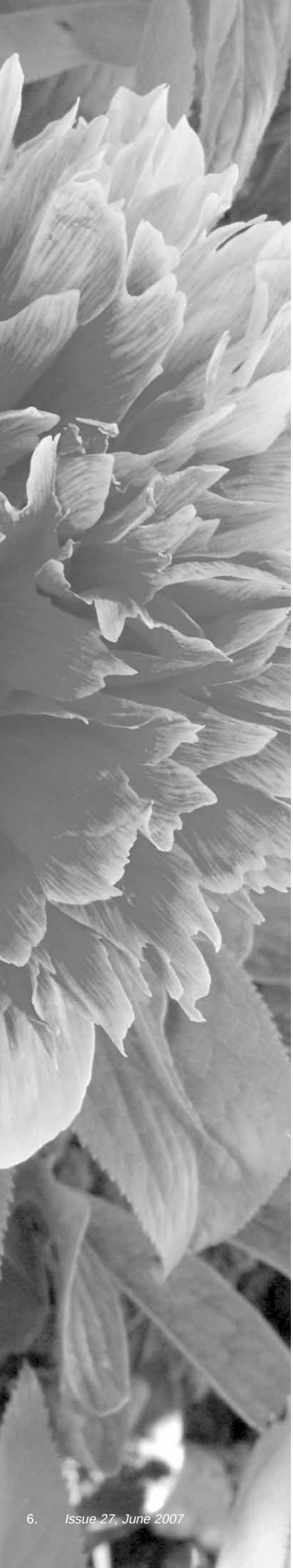

Adverse interaction between drug laxative and Paeony

Concerns about potential adverse interactions, which may result when herbal medicines are added to the treatment regimen of patients taking orthodox drug medicines, are in virtually all cases focussed on how the drug-induced effects may be reduced or enhanced by the natural treatment. This situation reflects both possible bias as well as a lack of research looking into the opposite situation, whereby introduction of a drug-based medicine compromises the effects of a natural one.

With the level of usage of complementary medicines being comparable to that of drug medicines in most population surveys, and in many cases these being taken on a long term basis or as alternatives to drug treatment, consideration of the potential outcomes when a drug is introduced should receive more attention[1].

The Chinese herb Paeony (*Paeonia lactiflora*) is widely used in formulations prescribed in Traditional Chinese and Japanese Medicine, and increasingly by western practitioners, as an analgesic, antispasmodic and tonic for the female reproductive system. In Japan, a traditional formulation containing Paeony root and Liquorice is co-administered with the laxative drug sodium picosulphate as a premedication to relieve the pain accompanying colonoscopy. The glycoside paeoniflorin is a principle active constituent, and this is known to be metabolised into the active antispasmodic aglycone paeonimetabolin-1 by intestinal bacteria following oral administration[2].

A study by Japanese researchers recently published in the online version of the journal *Phytomedicine*, investigated whether co-administration of sodium picosulphate influences the metabolism of paeoniflorin to this metabolite by intestinal bacteria in rats[3]. Sodium picosulphate in a dose which was ten times the common human dose was given orally to rats on day 0, followed five hours later by the Paeony and Liquorice formulation, which was given orally twice daily for nine days at a dose ten times the common human dose.

Following a single dose of sodium picosulphate, the ability of intestinal bacteria in rat faeces to metabolise paeoniflorin to its active metabolite was significantly reduced, to approximately 34% of initial levels. Plasma levels of the active Paeony metabolite also reduced to 8.3% of its initial levels, and the Area Under the Curve (AUC) for this metabolite was reduced to 16.1% of control levels. A significant impairment of the antispasmodic effect of Paeony was therefore indicated following a single laxative dose, although repeated administration of the herbal formulation over the next few days lead to recovery to initial levels.

Despite the obvious limitations in terms of extrapolating such findings to humans, this study shows that orthodox medicines such as laxatives, may cause a significant impairment of the glycoside-metabolising activity of intestinal bacteria, and thus therapeutic activity of Paeony. The same group of researchers have previously reported similar reductions in bioavailability of the active metabolites of paeoniflorin and liquorice-derived glycyrrhizin, during the initial stages following coadministration to rats of the antibiotic drugs amoxycillin and metronidazole[4,5]. Adverse interactions between stimulant laxatives or antibiotics and herbal medicines, leading to failure of the herbal medicine to impart desired therapeutic responses, is something that complementary practitioners should consider.

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Silymarin in Diabetes and Insulin Resistance

Milk thistle (*Silybum marianum*) seeds are well known for their many beneficial effects on the liver, due in large part to their content of several flavonolignans collectively known as silymarin. Various other potential benefits including anticancer[1,2], and neuroprotective[3,4] properties, have also been reported for this herb during recent years.

The liver has a close functional relationship with the pancreas, and insulin resistance is now known to be associated with non-alcoholic fatty liver disease[5]. This is an increasingly common cause of chronic liver damage, sometimes resolved by weight reduction, but which can lead to cirrhosis and liver cancer once steatohepatitis occurs.

Elevated glucose and free fatty acid levels in type II diabetic patients can lead to oxidative stress and subsequent diabetic complications as well as insulin resistance and impaired insulin secretion[6]. Silymarin as a powerful antioxidant[7,8], can prevent lipid peroxidation and its associated damage to pancreatic cells, as well as pancreatic toxicity during treatment with the immunosuppressant drug cyclosporine[9,10]. The faster recovery of pancreatic function observed when silymarin was administered to rats for nine weeks, was also associated with enhancement of levels of endogenous antioxidant enzymes such as superoxide dismutase, glutathione peroxidase, and catalase[11,12].

Raised levels of the enzyme aldose reductase are also seen in diabetic patients, and this catalyses the polyol pathway in nerve tissues, a metabolic abnormality associated with microvascular diseases seen in most long-term diabetic patients. Aldose reductase inhibitors have been shown to help prevent or slow down the onset of diabetic complications such as diabetic nephropathy, retinopathy and peripheral neuropathy[13, 14]. The effects of silymarin as an aldose reductase inhibitor[15, 16], could therefore also produce favourable effects of Milk thistle in diabetic patients.
Improvement in the hepatocyte functions of patients with non-insulin-dependent diabetes was first reported for silymarin by Russian researchers in 1993[17]. An open, controlled Italian study involving 30 insulin-dependent diabetic patients with alcoholic cirrhosis who were treated with silymarin for one year, also found several benefits, including a significant decrease in the need for insulin administration and fasting insulin levels, as well as in malondialdehyde levels[18]. These results indicated possible inhibition of lipoperoxidation of cell membranes and a reduction in insulin resistance, leading to both reduced overproduction of endogenous insulin as well as the need for extra insulin therapy.

Clinical trial in Type II Diabetes

To investigate the possible benefits of silymarin in diabetes further, Iranian researchers recently undertook a randomised double-blind clinical trial involving 51 type II diabetic patients[19]. Patients were aged between 40 and 65, and had diabetes of more than two years in duration which was being treated with the oral hypoglycaemic drugs glibenclamide and metformin. None were receiving insulin therapy.

The treatment group of 25 patients received a dose of 200mg silymarin or placebo three times daily before meals over a four month period. Blood levels of glycosylated haemoglobin (HbA1c, the gold standard for monitoring glycaemic control), fasting blood glucose, insulin, total cholesterol, LDL and HDL, triglyceride, and the liver enzymes SCOT and SGPT were measured at the beginning and after four months of silymarin or placebo treatment. Patients were also visited and examined every month during the study, to check fasting blood glucose levels as well as compliance. The placebo and treatment groups were well matched at baseline, apart from the fact that triglyceride levels were higher in the silymarin group.

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During silymarin treatment, improvement in several parameters was measured. Fasting blood glucose levels dropped from 156 to 133mg/dL and average HbA1c levels fell from 7.82 to 6.78% in the treatment group. In the placebo group however, both parameters increased, from 167 to 188mg/dL and from 8.29 to 9.45% respectively. Silymarin treatment also produced a significant drop in blood levels of total cholesterol, LDL, triglyceride, SGOT and SGPT. Effects on serum insulin levels were statistically insignificant, and a slight decrease in weight and blood pressure was measured, although these were also insignificant.

No adverse effects were reported and at the completion of the study many silymarin-treated patients expressed a wish to continue the same treatment.

This small controlled clinical trial provides convincing support for the beneficial effects of silymarin in type II diabetic patients. While in this trial it was taken as adjunctive therapy during concurrent oral hypoglycaemic drug treatment, it seems likely also that daily silymarin could perhaps help delay or avoid the need for such drug treatment, if given to patients in the early stages of this increasingly common and widespread disease. Based on the evidence to date, such benefits could also extend to type I diabetic patients receiving insulin therapy. Further investigations using larger numbers of patients with both type I and type II diabetes seem warranted.

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Protective effects of Ginkgo against alcohol-induced liver injury

The beneficial effects of standardised extracts of Ginkgo biloba leaf for circulatory conditions and as a cognition enhancer are well known. These activities seem to relate particularly to the antioxidant and anti-ischaemic properties of its flavonoid and terpene lactone constituents. Ginkgo leaves also have a very bitter taste when taken orally, which as with many other useful liver herbs, suggests the possibility of favourable effects also on this organ.

Positive effects on liver function were first reported in a preliminary study by Chinese researchers in 1995, in which patients with chronic hepatitis B showed signs of a partial remission of liver fibrosis and improvement in blood parameters[1]. Hepatoprotective activity by large doses of Ginkgo against carbon tetrachloride-induced liver toxicity in rodents was shown by Turkish workers in 1997[2], an effect since confirmed by further studies[3,4,5]. Protective effects against other liver toxins including paracetamol[6,7], thioacetamide[4], and thermal trauma[8], have also been demonstrated.

As discussed previously in *Phytonews 19*[11], potential benefits of Ginkgo to help prevent or treat serious liver diseases including cirrhosis, fibrosis and hepatocellular carcinoma, have been implicated in other *in vitro* and animal studies[9,10]. Significant Ginkgo-induced suppression of the growth of two different human hepatocellular cancer cell types was measured in one study[9], and reductions in the level of liver fibrosis and improvements in abnormal serum biochemistry were seen in another following Ginkgo administration to rats for four weeks[10]. More recent research has suggested that biliary obstruction-induced liver damage, and the damage to mitochondria associated with aging, could also be reduced by Ginkgo[12, 13,14].

Ginkgo flavonoids were reported to have beneficial effects in reducing the adverse effects of acute alcohol ingestion in mice, by Chinese researchers in 2005. Several effects were observed, including lessening of the alcohol-induced damage to serum and liver endogenous antioxidising systems such as glutathione and superoxide dismutase[15].

These possible protective effects of Ginkgo in the situation of liver injury as a result of more chronic alcohol use have now been investigated by two separate teams of Chinese workers[16,17].

In the first study, a chronic alcohol plus fish oil model of alcohol-induced liver disease was employed in rats, in which a dose of 8g/kg of alcohol and 2.5ml/kg of fish oil was administered by intragastric gavage for eight weeks. Blood samples were then analysed for alanine aminotransferase (ALT) enzyme activity, and livers examined for levels of tumour necrosis factor-alpha (TNF-α) and activities of the enzymes malondialdehyde (MDA) and glutathione (GSH), markers of lipid peroxidation.

As expected, rats given fish oil plus alcohol developed several signs of alcoholic liver disease, including mild inflammation, macrovesicular and microvesicular steatosis, and spotty necrosis. Serum ALT levels and expression of TNF-α mRNA were also elevated, these changes being accompanied by increased MDA and reduced GSH activities.

In the group of rats given a large dose (200mg/kg) of Ginkgo extract concurrently with the alcohol, several results indicative of a dampening of the alcohol-induced adverse effects on the liver were obtained. These included reduced liver necro-inflammation, a lower rise in serum ALT levels, no elevation in levels of TNF-α, and reversal in the elevation of MDA and fall in GSH.

Similar results were obtained in the other recent study, which was of similar design. This involved a lower dose of 2.4ml/kg of alcohol and a lower but still high dose of 48 or 96mg/kg of Ginkgo extract, given to rats for a longer period of ninety days[16]. Liver damage was found to be markedly reduced in a dose-dependent manner as shown by reduced macrovesicular steatosis and parenchymatous degeneration in hepatocytes, and reduced serum ALT levels.

A reduction in alcohol-induced glutathione depletion and lipid peroxidation, and

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inhibition of the inactivation of superoxide dismutase, glutathione peroxidase and catalase was also measured. The authors also reported a further favourable effect of upregulation of hepatic microsomal heme oxygenase-1 by Ginkgo, an enzyme involved in enhancement of antioxidative capacity.

Alcoholic liver disease is a major human health problem, with oxidative stress known to be involved in its initiation and development[18]. The results of these two studies show that Ginkgo when given in very large doses to rats produces a number of effects which protect against liver damage due to regular heavy alcohol intake, probably as a result of its many antioxidant activities. Improvement in hepatic microcirculation, as measured in a recent study involving Ginkgo's hepatoprotective effects[19] and suggested also as a mechanism of its beneficial effects on the liver following ischaemia[20], may also be contributory.

While both animal studies in which doses much higher than those normally taken by humans were used, this research provides further evidence of a beneficial effect of this phytomedicine on liver function. Taken together with other published research on this subject during recent years, the data supporting use of Ginkgo as a useful treatment or preventative for a broad-spectrum of liver conditions is now rather convincing.

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Organic kiwifruit healthier than non-organic

While proponents of organic agriculture often claim superior health properties for organically produced foods than those from conventional production systems, others have challenged this[1]. Research published recently in the *Journal of the Science of Food and Agriculture*, however, provides evidence that the nutritional profile of organically grown kiwifruit is healthier than conventionally grown fruit[2].

The study, undertaken in 2004 by researchers based in the Department of Plant Sciences at the University of California, involved comparing two blocks of kiwifruit (*Actinidia deliciosa*, Hayward variety) grown 1.6km apart, both planted in 1981 as grafted seedlings from the same nursery. All treatments made to the organic block were in compliance with the US National Organic Program and were certified organic. Those made to the conventional block included glyphosate (Roundup®) twice yearly as a weedkiller, a synthetic scale insect control spray, and hydrogen cyanamide as a spray to help overcome inadequate winter chilling during the final year. The organic block received more fertiliser treatments than conventionally grown kiwifruit, yet organic production averaged 22.5 tons per hectare compared to 26.9 tons per hectare for conventionally grown fruit.

Fruit were harvested at the same time from both blocks, and groups of representative samples analysed at the Postharvest Pomology Laboratory at the University of California at Davis. A range of parameters were measured, including morphological and physical attributes of the initial samples, maturity indices, and components associated with the nutritional quality of the fruit.

Organic kiwifruit had a greener colour and thicker skin, and were about 20% less firm than the conventional fruit at harvest. After storage at 0ºC for 4 months or at 20ºC for 7 days, levels of sugars and organic acids were similar in both types of fruit, but all of the measured concentrations of minerals (nitrogen, phosphorous,

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potassium, sulphur, boron, calcium and magnesium) were higher in organic kiwifruit. Levels of vitamin C and total phenolics were also higher in the organic kiwifruit, resulting in a higher measured antioxidant activity.

The authors suggest that conventional growing practices involving pesticides as well as the herbicide glyphosate can result in disruption of phenolic metabolites in the plant, that have a protective role in plant defence mechanisms. Sublethal treatments of glyphosate have been shown to alter phenol accumulation in young developing velvetleaf tissues[3], although its effects on fruits have apparently not been investigated. Recent research suggests the toxicity and endocrine disruption potential of glyphosate has perhaps been under-estimated[4], and pronounced adverse effects on amphibian biodiversity and fish have been reported following relatively normal use[5,6,7].

The premise that growing food organically rather than conventionally is better for human health has been supported by other studies undertaken during recent years. Better organoleptic characteristics (taste, smell and texture) and higher resistance to deterioration has been reported for organic strawberries[8], while higher antioxidant activity of organically grown fruits such as peaches and pears[9], strawberry and marionberry[10], wine grapes[11] and plums[12] has been documented. A study previously mentioned in *Phytonews*[13,14] which compared rats fed on a long term diet of vegetables and rapeseed oil grown organically with those fed with the same foods not grown organically, also revealed better health outcomes through the organic diet. These included higher plasma levels of vitamin E and immunoglobulin G (IgG), a tendency towards a lower weight and amount of adipose tissue, and more relaxed daytime behaviour, indicating possible better sleep quality in these nocturnal animals.

The rationale of organic versus conventional agriculture is based not only upon the claimed superior health promoting properties to consumers of the foods thus produced, but also upon favourable and more sustainable outcomes in terms of the environment and soil in which food is farmed. Findings from a previously reported Swiss study into the long term effects of organic agriculture on the types and biodiversity of soil microorganisms, which found organic farming to result in significantly higher levels and species diversity for a particular type of fungi known to play a crucial role in nutrient acquisition and soil fertility, are therefore of additional interest[15,16].

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Nitrites in cured meat may increase risk of COPD

Epidemiological studies have implicated consumption of smoked, salted or processed meat to have an association with certain forms of cancers such as colorectal, oesophageal and brain cancer[1,2,3,4,5]. An aetiological role for the high levels of nitrite compounds which are added to meats such as bacon, salami, cured ham, sausage and luncheon meats as a preservative to retard rancidity, stabilise flavour, and establish the characteristic pink colour of some cured meat products, has been suggested[6,7]. Increased formation of nitric oxide and carcinogenic nitrosamines by dietary nitrites, are thought to be responsible for these effects

Recently reported results from an American study, have now revealed evidence of a possible link between the intake of cured meat products and the risk of chronic obstructive pulmonary disease (COPD)[8]. These findings are likely to be particularly significant as they were based upon a large and well-controlled study. This was based upon analysis of data from 7,352 participants aged 45 years of older, in the Third National Health and Nutrition Examination Survey, by researchers from Columbia University Medical Centre in New York.

A cross sectional study methodology was used in which data was reviewed from all participants who had adequate measures of cured meat, fish, fruit and vegetable intake, and had undergone spirometry lung function measurements. Adjustments were made to take several other potential contributory factors into account, including age, sex, smoking and ethnic group, as well as other dietary factors such as intakes of fish, fruits, vegetables, vitamin C, β-carotene, and vitamin or mineral supplements

After adjusting for differences in measured forced expiratory volumes (FEV1) between individuals who did not consume cured meats and those who consumed bacon, salami, cured ham, sausage, luncheon meats, or meat within ready meals at different levels ranging from one to two to 14 or more times per month, a strong association was found between the level of cured meat consumption and an obstructive pattern of lung function. Those who ate cured meats from one to two times per month were 11% more likely than those who ate none to have COPD, while consumption on average at least once every two days (at least 14 times per month) was associated with a 91% increase in development of COPD.

Male smokers from relatively low socioeconomic backgrounds, were found to be the highest consumers of cured meats in this American study.

COPD is characterised by chronic inflammation of the bronchioles, and leads to excessive mucous production, fibrosis and protein degradation. While it is a disease which affects mainly smokers, a reported 10% of those who die from COPD have never smoked, suggesting the presence of other factors beyond smoking that may play a role in the development of this disease.

The authors commented that nitrites are prooxidants and generate reactive nitrogen species that may cause damage to the lungs, producing structural changes resembling emphysema. These findings are consistent with animal studies which found that rats fed long term with dietary nitrite developed dilated coronary arteries and pulmonary emphysema[9].

The possible negative effects on the lungs from dietary intake of these compounds may extend also to other pathologies beyond COPD. While possibly a result of increased production of nitric oxide by tumour cells[10], higher serum levels of nitrites and nitrates have been reported in a group of 31 primary lung cancer patients recently[11]. Survival rates were also significantly lower for those found to have higher than normal levels of these compounds in their blood.

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