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**ZESPRI™ Kiwifruit Boost the Body's Immune System and
Strengthens Natural Defenses**

ZESPRI™ GREEN and ZESPRI™ GOLD kiwifruit may strengthen the body's natural defenses for everyday protection, according to studies published this week in *Proceedings of the Nutrition Society of New Zealand*.

ZESPRI™ Kiwifruit have been found to boost the body's immune system, improve digestive health and muscle performance, and reduce inflammation and cell damage.

This latest research, part of ZESPRI's science program to demonstrate the health benefits of kiwifruit, supports previous studies that show kiwifruit can help strengthen natural defenses for everyday protection.

The new studies have found that ZESPRI™ GREEN and ZESPRI™ GOLD may provide the following benefits:

- Enhance the body's natural immune response, allowing it to fight off colds, the flu and other illnesses¹
- Reduce inflammation which is associated with long-term diseases such as arthritis, cancer, heart disease, diabetes and obesity²
- Assist in achieving the optimum balance between good and bad bacteria in the intestines³
- Protect against cancer associated enzymes in the lower digestive tract³
- Protect muscles against exercise-related oxidative stress².

ZESPRI™ Kiwifruit is full of nutrients, with high levels of vitamins C and E, anti-oxidants and fibre. It is considered to be one of the new 'superfruits' because of its added benefits to the body over and above basic nutrition.

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“We all know that consuming fruit is good for us, but we wanted to know if kiwifruit in particular has a beneficial effect on the body’s natural defense system,” says Lynley Drummond, Health Science Manager at ZESPRI International.

“These studies are an exciting step forward and support growing evidence that ZESPRI™ Kiwifruit can strengthen the immune system and protect the body in many ways.”

The three studies published this week in *Proceedings of the Nutrition Society of New Zealand*, were conducted in New Zealand at the New Zealand Institute for Plant & Food Research and Massey University.

Other evidence highlighting ZESPRI™ Kiwifruit’s natural health protection qualities includes studies published earlier this year that found mice consuming kiwifruit extract had stronger immune responses compared to the placebo group^{4,5}. Levels of protective immunity cells, which identify and destroy harmful foreign bodies, were elevated in groups fed kiwifruit.

ZESPRI™ is a grower owned cooperative of New Zealand kiwifruit growers, with the aim of ensuring top quality ZESPRI™ GREEN and GOLD kiwifruit are provided to consumers around the world, all year round.

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About ZESPRI International limited

ZESPRI™ is a cooperative of New Zealand kiwifruit growers that supply top quality kiwifruit all year round to both local and global markets. ZESPRI’s product portfolio comprises three variants: ZESPRI™ GREEN, ZESPRI™ GOLD and ZESPRI™ ORGANIC. ZESPRI is the world’s largest marketer of Kiwifruit, selling kiwifruit in over 65 countries.

Research Abstracts:

1. Title: Health benefits of ZESPRI GOLD Kiwifruit: Effects on muscle performance, muscle fatigue and immune responses.

Proceedings of the Nutrition Society of New Zealand, 2008, Volume 32, pages 49-59. Forty Second Annual Conference held in combination with the Australian Nutrition Society at Massey University, Albany Campus, Auckland, New Zealand (December 2007).

Authors: Skinner MA, Hunter DC, Denis M, Parlane N, Zhang J, Stevenson LM, Hurst R.

Abstract: Kiwifruit is one of the most nutrient dense fruits and a good source of vitamins, minerals, dietary fibre and plant phytochemicals, particularly carotenoids. Kiwifruit has been shown to provide health benefits beyond basic nutrition and evidence is mounting to support kiwifruit as a new ‘superfruit’. During exercise and training the body is “stressed” and immune responses may be compromised. A functional food with beneficial effects on these processes would have tremendous positive attributes. We investigated the ability of ZESPRI™ GOLD Kiwifruit to protect cells from oxidative stress, improve muscle cell function, reduce muscle fatigue and enhance immune

responses. Protection from oxidative stress by kiwifruit extract was investigated using neuroblastoma cells, exposed to hydrogen peroxide at a level sufficient to induce cell death. To investigate effects on muscle, soleus muscles from adult male mice were connected to force transducers in an organ bath and stimulated with electrodes to twitch and fatigue (over 15 seconds) with or without a 15 minute pre-incubation with the kiwifruit extract. For immune response effects, mice were fed a ZESPRI™ GOLD Kiwifruit puree for 20 days during which time they were orally immunised with a model protein antigen, ovalbumin (OVA), plus a suboptimal dose of mucosal adjuvant. Antigen-specific antibodies and cell-mediated immune response were compared with immunised mice fed a sugar control. Across a range of concentrations, the ZESPRI™ GOLD Kiwifruit extract was found to protect cultured cells from oxidative stress similarly to blueberry, which is known for its strong antioxidative properties. The ZESPRI™ GOLD Kiwifruit-treated muscles displayed a marked increase in maximum force and a significant delay in fatigue onset compared with the untreated control muscles. Consumption of kiwifruit puree led to significant increases in OVA-specific antibodies (IgG1, IgG2b and IgG2c) in the sera following sub-optimal immunisation conditions and elevated IL-5 production from mesenteric lymph node cells. The results provide robust evidence that ZESPRI™ GOLD Kiwifruit can protect from oxidative stress, improves muscle performance, prolongs time to muscle fatigue and increases antigen-specific immunity. This fruit will therefore prove useful as a new type of functional food ingredient for sports drinks and others foods targeted at enhancing muscle performance and immune function.

2. Title: Anti-inflammatory effects of kiwifruit.

Proceedings of the Nutrition Society of New Zealand, 2008, Volume 32, pages 20-25. Forty Second Annual Conference held in combination with the Australian Nutrition Society at Massey University, Albany Campus, Auckland, New Zealand (December 2007).

Authors: Farr JM, Hurst SM, Skinner MA.

Abstract: Several foods have been reported to have anti-inflammatory effects, including kiwifruit. In this study the ability of natural water extracts of kiwifruit to reduce lipopolysaccharide (LPS)-induced tumour necrosis factor (TNF) α and interleukin (IL)-1 β production was evaluated *in vitro* as a measure of potential anti-inflammatory activity. Aqueous extracts from ZESPRI™ GOLD (*Actinidia chinensis* 'Hort16A') and ZESPRI™ GREEN (*A. deliciosa* 'Hayward') Kiwifruit cultivars showed promising activity with human THP-1 monocytes and peripheral whole blood, although differential effects were seen in individual donors. These results provide supporting evidence for *in vivo* studies to determine whether kiwifruit may be useful in diets to help combat the inflammation underlying many chronic diseases associated with modern lifestyles.

3. Title: Kiwifruit: The ability to positively modulate key markers of gastrointestinal function.

Proceedings of the Nutrition Society of New Zealand, 2008, Volume 32, pages 66-71. Forty Second Annual Conference held in combination with the Australian Nutrition Society at Massey University, Albany Campus, Auckland, New Zealand (December 2007).

Authors: Shu Molan AL, Kruger MC, Drummond LN.

Abstract: The consumption of kiwifruit is associated with a number of health benefits related to gastrointestinal function. These benefits are generally attributed to the high levels of vitamins, minerals, dietary fibre and bioactive phytochemicals present in kiwifruit. There is a need to investigate the biological activities of specific fractions of kiwifruit on markers of gastrointestinal health. Aqueous solutions were prepared from the edible flesh (EF) and water-extracts (WE) of both ZESPRI™ GOLD (ZGO) and ZESPRI™ GREEN (ZGR) Kiwifruit and assessed for their ability to influence the growth of both beneficial and pathogenic bacteria under *in vitro* conditions. In addition, the potential of kiwifruit to modulate the activity of β -glucosidase and β -glucuronidase was investigated. A series of *in vitro* experiments were conducted to evaluate both the antimicrobial and prebiotic properties, and intestinal bacterial enzyme activities of kiwifruit extracts using batch *in vitro* fermentation model using human faecal microbiota. Kiwifruit, and in particular the water extract of ZESPRI™ GOLD Kiwifruit demonstrated an ability to positively influence intestinal bacterial enzymes, by inhibiting β -glucuronidase activity and promoting the activity of β -glucosidase. In addition, extracts prepared from ZGO and ZGR kiwifruit were able to promote the growth of faecal lactic acid bacteria (LAB) especially at high concentrations and reduce the growth of *Escherichia coli*. This may explain the reduction of the activity of β -glucuronidase which is generated mainly by *E. coli*. The increase in activity of β -glucosidase may be due to the stimulation of the growth of LAB, which have high levels of β -glucosidase activity in comparison with the members of the gut microflora. It was concluded that both the edible flesh and, particularly, water extracts of ZGO and ZGR kiwifruit, exhibit antimicrobial and prebiotic activities when tested under *in vitro* conditions. Kiwifruits have also been shown to

beneficially modulate the intestinal bacterial enzymes, β -glucosidase and β -glucuronidase, in a manner that is considered beneficial for gastrointestinal health

4. Title: Kiwifruit extract enhances markers of innate and acquired immunity in a murine model. Food and Agricultural Immunology 2008; Volume 19, Issue 2 June 2008, pages 149 – 161.

Authors: Shu Q, Mendis De Silva U, Chen S, Peng W, Ahmed M, Lu G, Yin Y, Liu A, Drummond L.

Abstract: The present study examined the effects of a kiwifruit (*Actinidia chinensis* and *Actinidia deliciosa*) extract on immune response in BALB/c mice. The effects were investigated using cholera vaccine (11 days duration) and diphtheria/tetanus toxoid-vaccine (29 days duration) models. Mice were given either test (standard diet incorporated with kiwifruit extract) or control diets ad libitum throughout the respective experimental periods. At the end, blood, spleen and intestinal fluids were collected for determination of cell proliferation, specific antibody responses, cytokine production, phagocytosis, and natural-killer cell activity.

Kiwifruit extract significantly enhanced ($p < 0.05$) specific intestinal mucosal and serum antibody responses to the vaccines and promoted interferon- γ and natural killer cell activities. No significant ($p > 0.05$) improvement was observed in proliferative response, phagocytic activity and interleukin-4 production. The overall results of the present study demonstrate the ability of kiwifruit extract to enhance markers of innate and acquired immunity in the tested murine model.

For a full copy of the research paper, please go to:

<http://www.informaworld.com/smpp/content~content=a793614705~db=all~order=page>

5. Title: Feeding ZESPRI™ GOLD Kiwifruit puree to mice enhances serum immunoglobulins specific for ovalbumin and stimulates ovalbumin-specific mesenteric lymph node cell proliferation in response to orally administered ovalbumin.

Nutrition Research, Volume 28, Issue 4, April 2008, Pages 251-257.

Authors: Hunter DC, Denis M, Parlane NA, Buddle BM, Stevenson LM, Skinner MA.

Abstract: The health benefits of fruits have been recognised for some time, but only recently have their effects on the immune system been investigated. Kiwifruit contains vitamins, minerals, and phytochemicals that are known to be important for normal functioning of the immune system. In this work, the influence of feeding two ZESPRI™ GOLD Kiwifruit processed products (Tauranga, New Zealand) on immune function in mice was investigated. Using a model to demonstrate adaptive immune responses in the gut, mice were fed either ZESPRI™ GOLD Kiwifruit puree or ZESPRI™ GOLD Kiwifruit 40° Brix Juice concentrate for 20 days, during which time they were immunized via the oral route with ovalbumin and subsequently given a suboptimal dose of the mucosal adjuvant cholera toxin. ZESPRI™ GOLD Kiwifruit puree enhanced the response to ovalbumin by significantly increasing the levels of total immunoglobulins and immunoglobulin G specific for ovalbumin and enhanced the antigen-specific proliferation of cells from the draining mesenteric lymph nodes compared with mice fed a 20% sugar control. These results indicate that ZESPRI™ GOLD Kiwifruit can modulate an antigen-specific immune response and suggest that ZESPRI™ GOLD Kiwifruit may represent a new type of functional food ingredient.

For a full copy of the research paper, please go to:

http://www.sciencedirect.com/science?_ob=MIimg&_imagekey=B6TB1-4S7J1X7-6-5&cdi=5129&user=10&orig=browse&coverDate=04%2F30%2F2008&sk=999719995&view=c&wchp=dGLzVzzzSkzS&valck=1&md5=77ea07ff701456a6f92171e252c0e91f&ie=/sdarticle.pdf