



MUSHROOMS AND HEALTH GLOBAL INITIATIVE BULLETIN

An ISMS Global Initiative to increase the worldwide consumption of mushrooms through the collection, evaluation and dissemination of scientifically validated information.

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News from the Initiative - Greg Seymour

As we enter the fourth year of the Mushrooms and Health Global Initiative (M&HGI) it is pleasing to report that we continue to meet all our project objectives and that we are seeing the outputs of the project increasingly being used to underpin public relations and promotional campaigns in various parts of the world. The splendid group of experts that makeup the M&HGI Team and the Strategic Communications Group (listed on the last page of the *Bulletin*) coordinated by Mary Jo Feeney continue to achieve results beyond what we envisaged when we first began the project during the 4th International Medicinal Mushroom Conference in Slovenia (2007). Thanks to all of them for giving so freely of their knowledge, skills and networks and putting in plenty of hard work. Two important challenges in this coming year are to secure sufficient funding to keep the project going over the next three years; and to continue to spread the word to as many people as possible inside and outside our industry. Hopefully our existing investors will invest again because they are seeing the benefits of the project in their marketplace as clearly as we are seeing it in Australia. I also hope that many potential investors on our distribution list who have only learnt about, or benefited from the M&HGI project over the last couple of years, come forward and contact Mary Jo (info@mushroomsandhealth.com) to become part of our global funding network.

Finally, a big thanks to all of you on our distribution list. It is through you that the word is spreading. However, I ask you to do something a bit extra in 2011 – please introduce the M&HGI *Bulletin* to ten colleagues in the mushroom supply chain and ten people you know who might be interested in improving their health and well-being. Just forward the email with a little introductory comment – that's how the social network Facebook began.

Onward and upward. Cheers.

Greg Seymour

It is through
you that the word
is spreading.

Mushrooms and Health Website

- Mary Jo Feeney

The [Mushrooms and Health website](#) provides you with the latest credible scientific information on the health and wellness benefits of eating mushrooms. [The Mushrooms and Health 2010 Report](#) is the most visited section and information on mushrooms' antioxidant properties is the most viewed topic. Significant antioxidant activities *in vitro* have been reported in several varieties of mushrooms, with one study reporting antioxidant capacity comparable to vitamin C. Antioxidant activities appear to be related to the polyphenolic content. Of particular interest is that the antioxidant activity (free radical scavenging activity) along with total phenolic and flavonoid concentrations appear to be similar in mushrooms before and after boiling, suggesting that the antioxidant capacity of mushrooms is thermostable (to heating over 100°C for extended periods of time e.g. 30 min) and in some cases increases during heating, suggesting that antioxidant activity would be maintained in cooked mushrooms. L-ergothioneine is a biologically active antioxidant in mushrooms, and its production in mushrooms can be enhanced by addition of histidine to the growth medium/compost. For more information on the antioxidant properties of some specific mushrooms, visit the website and click on the [Antioxidant Properties](#) section of the [Mushrooms and Health 2010 Report](#).

Mushroom Research

See the following review articles describing the research and potential health benefits of wild, cultivated and medicinal mushrooms, and the articles on mushroom's potential role in arthritis and cardiovascular disease.

► **Review of mushroom's benefits**

Cheung PCK. "[Nutritional and health benefits of mushrooms.](#)" *Nutrition Bulletin* 2010 35:292-299. doi:10.1111/j.1467-3010.2010.01859.x.

This review describes the nutrient values, health effects and bioactive compounds of some wild and cultivated mushrooms with sections on cell wall polysaccharides, low and high molecular weight compounds. The authors maintain that mushrooms contain a large array of nutrients and natural phytochemicals with a wide range of nutritional and health benefits with potential to boost the immune system, provide anti-cancer function, and control blood lipids and glucose levels in humans.

► **Medicinal mushrooms – findings, trends and unsolved problems**

Wasser SP. "[Current findings, future trends, and unsolved problems in studies of medicinal mushrooms.](#)" *Appl Microbiol Biotechnol* 2010; Dec 29. Epub ahead of print.

This review draws attention to many important unsolved problems in the future development of medicinal mushroom science in the twenty-first century. The review summarizes data on mushroom polysaccharides for approximately 700 species of higher Hetero- and Homobasidiomycetes. The chemical structure of polysaccharides, connection to antitumor activity, possible ways of chemical modification, experimental testing and clinical use of antitumor or immunostimulating polysaccharides, and possible mechanisms of their biological action, are discussed. Numerous bioactive polysaccharides or polysaccharide-protein complexes from medicinal mushrooms also are described that appear to enhance innate and cell-mediated immune responses

and exhibit antitumor activities in animals and humans. Several of the mushroom polysaccharide compounds have proceeded through phases I, II, and III clinical trials and are used extensively and successfully in Asia to treat various cancers and other diseases. A total of 126 medicinal functions are thought to be produced by medicinal mushrooms and fungi including antitumor, immunomodulating, antioxidant, radical scavenging, cardiovascular, antihypercholesterolemia, antiviral, antibacterial, antiparasitic, antifungal, detoxification, hepatoprotective, and antidiabetic effects.

► **Advances in lentinan research**

Zhang Y, Li S, Wan S, Zhang L and Cheung PCK. "Advances in lentinan: Isolation, structure, chain conformation and bioactives". *Food Hydrocolloids* Epub online ahead of print. March 2011. Vol. 25; No. 2; 196-206.

This review paper on lentinan, a β -(1→3)-d-glucan isolated from a common edible mushroom, *Lentinus edodes*, includes 156 citations. According to the authors, lentinan's medicinal application is hindered by technical difficulties in extraction, purification, and a lack of thorough understanding of polysaccharide's structure and function relationship. The review covers different areas of research in the past 40 years.

► **Mushroom polysaccharides and immune function – a review**

Ramberg JE et al. "Immunomodulatory dietary polysaccharides: A systematic review of the literature." *Nutrition Journal* 2010, 9:54.

This systematic review of articles published in English, evaluated the available data through 2009, regarding the specific immunologic effects of dietary polysaccharides identified by PubMed and Google Scholar electronic searches and through reviews of polysaccharide article bibliographies. Results of the review found 62 publications reporting statistically significant effects of orally ingested glucans, pectins, heteroglycans, glucomannans, fucoidans, galactomannans, arabinogalactans and mixed polysaccharide products in rodents. Fifteen controlled human studies reported that oral glucans, arabinogalactans, heteroglycans and fucoidans exerted significant effects. Although some studies investigated anti-inflammatory effects, most studies investigated the ability of oral polysaccharides to stimulate the immune system. These studies, as well as safety and toxicity studies, suggest that these polysaccharide products appear to be largely well-tolerated.

The authors conclude that taken as a whole, the oral polysaccharide literature is highly heterogenous and is not sufficient to support broad product structure/function generalizations. Numerous dietary polysaccharides, particularly glucans, appear to elicit diverse immunomodulatory effects in numerous animal tissues, including the blood, GI tract and spleen. Glucan extracts from the *Trametes versicolor* mushroom improved survival and immune function in human randomized controlled trials (RCT) of cancer patients; glucans, arabinogalactans and fucoidans elicited immunomodulatory effects in controlled studies of healthy adults and patients with canker sores and seasonal allergies. This review serves as a guide for future research on immune modulation by well-characterized polysaccharide compounds.

► **Mushrooms and collagen-induced arthritis**

Chandra LH, Alexander H et al. "White button and shiitake mushrooms reduce the incidence and severity of collagen-induced arthritis in dilute brown non-agouti mice." *J. Nutr.* 2011; 141 (1):131-136.

This study investigated the effects of white button mushrooms (WBM) and shiitake mushrooms (SM) on collagen-induced arthritis (CIA) using a 2 x 3 factorial design in 8-wk-old female dilute brown non-agouti mice that were fed a control diet or the same diet supplemented with 5% lyophilized WBM or SM for 6 wk.

CIA, induced by immunizing mice with 100 microg bovine collagen followed by 50 microg LPS on d 20 post-collagen injection, was assessed by mononuclear cell infiltration, bone erosion, plasma IL-6, TNFalpha, and intercellular adhesion molecule-1 (sICAM-1) concentrations. Compared with the control diet, WBM and SM tended to reduce the CIA index from 5.11 +/- 0.82 to 3.15 +/- 0.95 (P = 0.06) 31 d post-collagen injection. Whereas 58% of control mice had a CIA index >= 7, only 23% of WBM and 29% of SM mice did (P = 0.1). Although both types of mushrooms reduced plasma TNFalpha (34%, WBM; 64%, SM), only SM increased plasma IL-6 by 1.3-fold (P < 0.05). The CIA index was positively correlated with sICAM1 (r = 0.55; P < 0.05) but negatively correlated with TNFalpha (r = 0.34; P < 0.05). Whether mushrooms are beneficial for arthritis management remains to be investigated; but the investigators maintain that is the first report demonstrating a possible health benefit of WBM in arthritis treatment.

► **Anti-inflammatory effect of *Agaricus blazei* Murill extract**

Foland DT, Johnson E et al. "Effect of an extract based on the medicinal mushroom *Agaricus blazei* Murill on expression of cytokines and calprotectin in patients with ulcerative colitis and Crohn's disease." *Scand J Immunol* 2011 73(1): 66-75.

This study investigated whether AndoSan™, an extract based on *Agaricus blazei* Murill (AbM) previously shown to have an anti-inflammatory effect in healthy volunteers, had similar effects on cytokines in patients with ulcerative colitis (UC) and Crohn's disease (CD). Calprotectin, a marker for inflammatory bowel disease (IBD), was also measured.

Eleven patients with CD and 10 patients with UC consumed 60ml/day of AndoSan™. Patient blood plasma was harvested before and after 6h LPS (1ng/ml) stimulation *ex vivo*. Plasma and faecal calprotectin levels were analysed using ELISA and 17 cytokines [IL-2, IFN-γ, IL-12 (Th1), IL-4, IL-5, IL-13 (Th2), IL-7, IL-17, IL-1β, IL-6, TNF-α, IL-8, MIP-1β, MCP-1, G-CSF, GM-CSF and IL-10] by multiplex assay. Baseline concentrations for the 17 cytokines in the UC and CD patient groups were largely similar.

After 12 days' ingestion of AndoSan™, baseline plasma cytokine levels in UC was reduced for MCP-1 (40%) and in LPS-stimulated blood for MIP-1β (78%), IL-6 (44%), IL-1β (41%), IL-8 (30%), G-CSF (29%), MCP-1 (18%) and GM-CSF (17%). There were corresponding reductions in CD: IL-2 (100%), IL-17 (55%) and IL-8 (29%) and for IL-1β (35%), MIP-1β (30%), MCP-1 (22%), IL-8 (18%), IL-17 (17%) and G-CSF (14%), respectively. Faecal calprotectin was reduced in the UC group. Ingestion of an AbM-based medicinal mushroom by patients with IBD resulted in interesting anti-inflammatory effects as demonstrated by declined levels of pathogenic cytokines in blood and calprotectin in faeces.

► **Agaricus blazei Murill and anti-tumor activities – possible mechanism**

Lee JS, Hong EK. "Agaricus blazei Murill enhances doxorubicin-induced apoptosis in human hepatocellular carcinoma cells by NFkappaB-mediated increase of intracellular doxorubicin accumulation." *International Journal of Oncology* 2011 38 (2): 401-408.

Agaricus blazei Murill (ABM) mushroom consists of polysaccharides possessing anti-tumor activities. The mechanisms by which ABM inhibit hepatocellular carcinoma remain unknown. This study demonstrated that ABM acts as an enhancer to sensitize doxorubicin (Dox)-mediated apoptotic signaling, and this sensitization can be achieved by enhancing intracellular Dox accumulation via the inhibition of NFkappaB activity. When combined with low doses of Dox, these findings suggest that ABM has the potential to provide more efficient therapeutic effects against drug-resistant human hepatocellular carcinoma.

► **Ergothioneine interrupts events in early cardiovascular disease**

Martin KR. "The bioactive agent ergothioneine, a key component of dietary mushrooms, inhibits monocyte binding to endothelial cells characteristic of early cardiovascular disease." *Journal of Medicinal Food* December 2010, 13(6): 1340-1346. doi: 10.1089/jmf.2009.0194.

This study investigated whether ergothioneine (ERT) a novel antioxidant present in edible mushrooms, could interrupt pro-inflammatory induction of adhesion molecule expression associated with atherogenesis. Human aortic endothelial cells (HAECs) were incubated with increasing concentrations of ERT (0.01–10.0 mM) overnight (16 hours) followed by incubation with medium alone or with the pro-inflammatory cytokine interleukin (IL)-1 β (5 ng/mL) for 6 hours to induce expression of vascular cell adhesion molecule-1 (VCAM-1), intercellular adhesion molecule-1 (ICAM-1), and endothelial-leukocyte adhesion molecule (ELAM-1 or E-selectin). ERT at 0.1–0.3 mM significantly ($P < .05$) reduced VCAM-1, ICAM-1, and E-selectin expression up to 41%. VCAM-1 was suppressed to the greatest extent followed by E-selectin and then ICAM-1.

The study also tested if binding of preloaded U937 human monocytes to HAECs would be inhibited. U937 binding to HAECs was significantly reduced in IL-1 β -stimulated HAECs preincubated with 1 and 3 mM ERT. Unstimulated monolayers demonstrated marginal, but significant, reductions. ERT was not toxic to HAECs at any concentration used. According to the investigator, this data provides evidence that ERT found in commonly consumed dietary mushrooms can protect against events observed in atherogenesis, suggesting increased dietary intake of edible mushrooms would be a prudent medicinal means of reducing CVD risk.



News from Spain - Cristina Clavijo Sáenz and José Antonio Jiménez

Asochamp and the Spanish Heart Foundation (Fundación Española del Corazón, FEC) signed a collaboration agreement to include mushrooms in the Program Food and Health of the Spanish Heart Foundation (PASFEC). The foundation created this program with the aim of preventing cardiovascular disease in Spain.



Members of Asochamp can use the Spanish Heart Foundation's logo on their packaging.

Therefore they support foods which fulfill their demanded requirements, such as "low fat", "low sodium" and "no cholesterol", and as we all know, mushrooms meet them all. From now on, mushroom growers who are members of Asochamp can use the Spanish Heart Foundation's logo on their packaging. We hope consumers will "heart mushrooms"!

Asochamp and the mushroom technology centre (Centro Tecnológico de Investigación del Champiñón de La Rioja – CTICH) attended the *2nd Mediterranean Diet and Health Conference and Expo* which took place in Madrid last October (<http://www.dietamediterraneaysalud.com/>). The conference is a platform where doctors, nutritionists and businesses promote the benefits of a healthy lifestyle and the values of the Mediterranean diet in Spanish society.



CTICH researcher, Cristina Clavijo, gave two presentations "Nutrition and medicinal properties of mushrooms: Recent advances in science" and "Fungi and Mediterranean Diet: Nutritional aspects of mushrooms", aimed at health professionals and the consumer, respectively. At the booth (see photo), Cristina and Asochamp Chairman José Antonio Jiménez, answered questions on mushrooms and gave out hundreds of mushroom recipe books and brochures. The mushroom growers association also offered a mushroom tasting for more than 350 people at the central square of the pavilion.

Two of the biggest supermarket chains in Spain, Eroski and Simply (Auchan), have collaborated with Asochamp on mushroom promotion. More than 50,000 copies of the association's mushroom recipe book have been distributed to their stores to be placed with fresh mushrooms in the grocery department. See the mushroom recipe book (Spanish language) here: <http://www.ctich.com/informacion/recetario.pdf>.

News from the United Kingdom - Michal Slawski



Mushrooms were last given a major promotion in the United Kingdom (UK) nearly 20 years ago but that has all changed with initiatives spearheaded by the Mushroom Bureau, an organisation funded by mushroom growers and trade alliances to the industry in the UK and Ireland. In 2010 the Bureau (with the help of Bord Bia, the Irish Food Board), funded a £500,000 promotion of mushrooms in the UK market. 2011 marks the start of a €2.5 million mushroom promotion in the UK over the next three years. The promotion is funded by Bureau members and funds obtained from the EU with the assistance of Bord Bia and the Department of Agriculture, Fisheries and Food in Ireland.

The strategy is to implement a three year programme that broadens the role of mushrooms in the UK diet by surprising consumers about the nutritional benefits of mushrooms and reinforcing their taste and versatility. This will be done by communicating the benefits of mushrooms to households, doctors and nutritionists and mass caterers, using advertising in women's magazines, digital media, public relations (PR) and via educational measures.

The "More to Mushrooms Programme" will ensure that mushrooms play a more important role in helping the UK eat more healthily. Advantage will be taken of the prevailing attitudes towards food, in particular the



renewed interest in food and cooking from scratch and the nation's obsession with healthy eating. Positive communication and education are essential. Under the central campaign line "There's More to Mushrooms", mushrooms will be promoted in a new and exciting way, highlighting their nutritional value, taste and versatility.

In particular, the campaign will inform the target groups that mushrooms are a source of B-vitamins and minerals and, most importantly, that they contribute to the UK Government's recommended '5-a-day' portions of fruit and vegetables.

The strategy entails a carefully considered combination of channels to reach the target groups. Both women's magazines and digital channels are a critical strand of the media plan to reach households. Direct communications with health professionals coupled with PR activity will build additional dimensions around the central message. Direct communications with mass caterers will prompt reconsideration of mushrooms amongst this audience.

The programme has a target of increasing consumption by over 23,800 tonnes over three years in the UK market. An ongoing tracking study is in place to monitor the changes in attitudes to mushrooms as the promotion progresses.

The programme was launched in January of this year, targeting consumers with an interest in healthy eating after the holiday season. There will be two further bursts of activity this year, at the start of summer focusing on healthy low fat foods, and finally at the start of winter when the aim will be to get people into good eating habits for winter.

Stephen Allen, a spokesperson for the Mushroom Bureau, said "we expect that this significant investment made by the industry, and matched by the EU will give a timely boost to mushroom sales and provide for growth over the next three years".

The programme targets increasing mushroom consumption by over 23,800 tonnes over three years.



News from Australia - Glenn Cardwell

► Doctors get the mushroom message

The Australian mushroom industry continues to promote mushrooms through their work with doctors and nursing staff. The biggest doctors' gathering, the General Practitioners Conference and Exhibition, is held in Melbourne each November and proving to be a great opportunity to make the delegates far more knowledgeable about new research on the health benefits of mushrooms.

Glenn Cardwell, Accredited Practising Dietitian to the Australian Mushrooms Growers Association (AMGA), gave three workshops on nutrition and bone health and the potential role of mushrooms high in vitamin D. Fast Ed, celebrity chef, gave two cooking demonstrations using mushrooms, while Professor Rebecca Mason, Professor of Physiology at the University of Sydney presented a seminar with the latest information on vitamin D and health. Professor Mason's presentation was supported by the mushroom industry. Both the workshops and the seminar rated very highly with attendees, showing their demand for practical information.



Over 300 doctors and nurses joined the Mushroom Lovers' Club.

We were able to sign up over 300 doctors and nurses for the Mushroom Lovers' Club (see the photo of the health benefits of mushrooms display), which is a record for this event, giving us another avenue to educate health professionals

The promotion of mushrooms in the island state of Tasmania continues. We are developing a poster that summarises the health



benefits of mushrooms, partly because doctors and nurses have been requesting a health oriented poster to place in their consulting rooms. The poster includes health vignettes on vitamins, minerals, antioxidants, cancer prevention, heart health, immune health and weight control.

A version of the poster will be available online, whereby consumers can click on a health icon to learn more about the attributes of the mushroom. Like other mushroom industries around the world, we also promote the flavour benefits, such that including the mushroom in recipes can reduce the amount of salt required.



News from the United States - Heidi Gengler

► Institute of Medicine sets new vitamin D daily standards Mushrooms are part of the solution

In November 2010, the Institute of Medicine (IOM) released the results from its 24-month review on dietary reference intakes (DRIs) for vitamin D and calcium. In addition to validating the importance of vitamin D in promoting bone health, the committee set the recommended intake level for vitamin D at 600 IU, triple the level from 1997 that was previously considered adequate for most adults (200 IU).

A recommended intake of 600 IU (15 mcg) can reasonably be obtained through a conscientious diet including foods that provide vitamin D. All mushrooms are a source of vitamin D and thus a versatile ingredient to help Americans meet the new recommendations.

As such, the U.S. Mushroom Council (Council) communications (including media and influencer outreach) positioned mushrooms as a means to meet those needs. Leading vitamin D expert, Dr. Michael F. Holick, and well-known chef and registered dietitian, Jackie Newgent, contributed their expertise in partnership with the Council to clarify the new guidelines for consumers and help them weave more foods with vitamin D, like mushrooms, into their diets.

Mushrooms were associated with vitamin D in more than 50 articles, generating more than 20 million impressions.

In news surrounding the IOM report, mushrooms were associated with vitamin D in more than 50 articles, generating a reach of more than 20 million impressions. Notable coverage included broadcast news networks such as CNN, ABC and FOX; and major online/health portals like WebMD and LATimes.com (Los Angeles); and the leading print publication, *USA Today*. The Council also included the report's findings in the January nutrition newsletter and updated vitamin D collateral and web assets accordingly.

USA TODAY YouLife Charity begins online

Food sources of vitamin D

447	154	117	100	40-100	41
Salmon, 3 oz.	Tuna fish, light, canned in water, 1/2 cup	Milk, 1% fat, 1 cup	Orange juice, fortified, 1 cup	Cereal, fortified, 1 cup	Egg

Research shines a light on vitamin D requirements

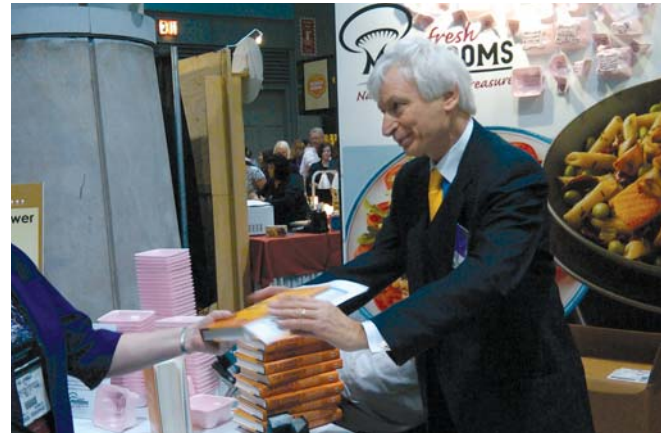
Those without a stellar diet may need to supplement

Dinner: 1/2 cup vitamin D rich mushrooms (grown in ultraviolet light) in stir-fry.

► **Mushrooms and nutrition experts take on Boston for American Dietetic Association's Annual Meeting**

The Council showcased the nutritional benefits of mushrooms at the American Dietetic Association's annual Food & Nutrition Conference & Expo (FNCE) in Boston, MA from November 7-9. Through event communications and booth traffic, the Council reached relevant health and nutrition professionals with messages about the benefits of mushrooms; focusing on breast cancer, vitamin D, immunity/antioxidants, low sodium and weight management.

Dr. Holick (featured in the photo) drew crowds to the booth for an appearance on the first day of the conference following his presentation at the session, "Vitamin D: Connecting Science to Health." In addition, the Council's "Wall of Pink" enabled attendees to pay tribute to loved ones who have faced breast cancer



by signing pink tills with inspirational messages and posting them on the booth walls. Taking advantage of the influx of industry experts in the Boston area, the Council held meetings with 15 influencers across multiple target areas (research, minority outreach, foodservice and media) to discuss joint opportunities in the coming year.

Be sure to visit the Mushrooms and Health website <http://www.mushroomsandhealth.com/>

These reports highlight the variety of ways different countries communicate the benefits of mushrooms to consumers, shoppers, households, doctors, health professionals and the media. Send what's happening in your country to info@mushroomsandhealth.com.

► **Initiative project team**

- Greg Seymour, President, ISMS General Manager AMGA, Australia; Manager, Mushrooms and Health Global Initiative
- Bart Minor, President, Mushroom Council, United States
- John Collier, Group Research and Development Manager, Monaghan Mushrooms Ltd, Republic of Ireland
- Mary Jo Feeney, Mushrooms and Health Global Initiative Operations Manager, Bulletin Editor, United States
- Glenn Cardwell, Accredited Practising Dietitian, Nutrition Impact P/L, Australia
- Chris Rowley, Communications Consultant, Australia
- Heidi Gengler, Vice President, Edelman Public Relations, United States

► **Strategic communications group**

Members of the Strategic Communications Group strengthen the Initiative's communication capability and develop a local public relations presence in each country whose industry is contributing financially to the project. Members of this group help facilitate stories about mushrooms and health appearing in their local media, monitor mushroom nutrition and health research, liaison with scientists, media and other influencers, and provide feedback to the Initiative. They include:

- Michal Slawski - United Kingdom
- Franz Schmaus - Germany
- Francois Marche - France
- Ignace Deroo, Evy Detroch - Belgium
- José Antonio Jiménez Hernandez - Spain
- Kent Stenvang - Denmark
- Raymond van Buuren - Netherlands
- Elizabeth O'Neil - Canada