

米国免疫学会での学会発表

2012.5.13
NPOフコイダン研究所

The American Association of immunologists (AAI: 通称、米国免疫学会)の2013年度年次総会が、5月3～7日の日程で、アメリカ・ハワイ州・ホノルルの Honolulu Convention Center で開催されました。

本学会は、アメリカを中心に世界各国で活躍する免疫学者が一同に集う世界最大規模の学術組織であり、「免疫学およびその関連分野」に関する理解を深め、免疫学の最新の知識に関して科学的な裏付けとなる情報を発信する事を目的として、毎年5月に年次総会を開催しています。

本総会は、今回で100回を数え、世界各国の大学や企業および国立機関に所属する研究者から2,000超の演題が提供され、過去最大規模での開催となりました。

NPOフコイダン研究所の理事長である宮崎義之氏は、「Protective effects of orally administered fucoidan mix on immunosuppression by an experimental cancer chemotherapy.」という演題でポスター発表を行い、フコイダンの機能の有効性について当学会の注目を集めました。

また、発表にあたり、当研究所理事の立川大介医学博士にも参加いただき、医学的にも大いに注目を集める事となりました。

本学会に関する情報は、AAI公式ホームページ(<http://www.aai.org/>)よりご参照ください。



学会会場入り口



学会会場外観



ホノルル市内の様子

Protective effects of orally administered fucoidan mix on immunosuppression by an experimental cancer chemotherapy

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Abstract
Fucoidan are sulfated polysaccharides derived from brown seaweeds that mainly consist of L-fucose. Peoples in Asian countries eat seaweeds willingly as healthy foods. In previous studies, we have demonstrated that fucoidan suggest anti-tumor immunity in an experimental mouse model and in healthy human subjects. However, availability of fucoidan to protect immune system from hazardous side effects of cancer chemotherapy has not been verified enough. Therefore, we performed a mouse model experiment in which immunosuppression was induced by subcutaneous 5-Fluorouracil (5-FU) injection (1 mg/mouse/day, 5 times on alternate days) and evaluated protective effects of orally administered fucoidan-agarcus mix (FAM, 40 mg/mouse/day). The immunosuppression by 5-FU was confirmed with the least spleen weights of 5-FU-injected mice. NK cell activity was lower in 5-FU-injected mice than sham-treated control mice, but the decline was recovered by the FAM feeding. The intake of FAM significantly alleviated the reduction in interferon (IFN)- γ production of splenocytes from 5-FU-injected mice. Furthermore, flow cytometric analyses revealed that specific population such as Th1 and CD11b⁺ cells were supported by the FAM feeding even in the 5-FU-injected mice. These results suggested that oral administration of FAM is effective to maintain tumor immunity during immunosuppressive cancer chemotherapy.

Introduction
Fucoidan is a line of fucose-containing sulfated polysaccharide which contains extracellular matrix component of brown seaweeds such as *Cladophora alismarum* (Chloroalginata) and *Enteromorpha flexilis* (Chlorophyta). Many valuable physiological functions have been reported in fucoidan. For example, fucoidan is known to improve serum lipid and sugar composition as similar to other water-soluble dietary fibers. As well as heparin derived from fungi, fucoidan has immunomodulatory effects, and it was reported that fucoidan activated innate immune cells in vitro. In previous study using tumor-bearing mice, we revealed that combined application of fucoidan with beta-galactosidase from *Agaricus bisporus* mycelia potentiated their immune stimulatory effects and anti-tumor activities. Furthermore, we performed an open-label trial for healthy volunteers. As shown in reference 1, NK cell activity was augmented by 142 times in the average at end of the trial than the initial value by the fucoidan-agarcus mix (FAM) intake for 30 days. The ratio of Th1 cells also increased, whereas Th2 cells decreased. Therefore, it was suggested that oral administration of FAM is effective to reinforce anti-tumor immunity in humans. In this study, we evaluated immunosuppressive effects of FAM to alleviate side effects in anti-cancer drug treatment, using a 5-FU-treated mouse model experiment.

Reference Figure 1.
Immune enhancing effects of fucoidan-agarcus mix in human (Five healthy volunteers took 2 g fucoidan a day)

Day	NK cell activities	Th1	Th2
Day 0	~10	~0.8	~1.2
Day 15	~15	~1.0	~1.0
Day 30	~15	~1.2	~0.8
Day 45	~15	~1.0	~1.0

Experimental Protocol

Group	Control	5-FU	FAM	FAM+5-FU
Number of mice	10	10	10	10
Age	12-14	12-14	12-14	12-14
Sex	5M/5F	5M/5F	5M/5F	5M/5F
Weight	20.0 ± 1.0	20.0 ± 1.0	20.0 ± 1.0	20.0 ± 1.0
Food intake	2.0 ± 0.2	2.0 ± 0.2	2.0 ± 0.2	2.0 ± 0.2
Water intake	1.0 ± 0.1	1.0 ± 0.1	1.0 ± 0.1	1.0 ± 0.1
Survival rate	100%	100%	100%	100%

Conclusion
NK cell activity was decreased to 75.7% of the control by 5-FU treatment, whereas daily intake of 40 mg FAM prevented this decline to 96.4%.
The production of IFN- γ by the spleen cells from 5-FU-treated mice was significantly augmented by the FAM feeding.
The FAM intake resulted in expansion of Th1, macrophages, NK cells and NKT cells even in the 5-FU-treated mice.

Results

Figure 1. Design of animal model for evaluating side effect associated with cancer chemotherapy (Myelosuppression by 5-FU treatment)

Figure 2. Augmentation of NK cell activity by fucoidan-agarcus mix ingestion in 5-FU-treated mice.

Figure 3. Augmentation of IFN- γ production by fucoidan-agarcus mix ingestion in 5-FU-treated mice.

Figure 4. Expansion of Th1 population by fucoidan-agarcus mix ingestion in 5-FU-treated mice.

Figure 5. Expansion of NK and NKT cells by fucoidan-agarcus mix ingestion in 5-FU-treated mice.

Figure 6. Expansion and activation of CD11b⁺ cells by fucoidan-agarcus mix ingestion in 5-FU-treated mice.

発表したポスター内容