※저널등재 증빙서류 제출 안내

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2. 공동 제1저자인경우 공동 제1저자여부 명시된 페이지 첨부 및 문장 형광펜 강조
3. 학과내규에 따라, 학생공동 주저자가 2명 이상인 논문의 경우, 같은 논문을 2명 이상이 제출할 수 없다.
4. SCI(E)와 JCR 랭킹 조회 페이지 붙임파일 "논문SCI,SCIE검색 방법" 참고
5. 제출자 본인이 학과내규에 적합한 증빙서류를 준비 및 확인하여 제출한다

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Dietary Whey Protein Supplementation Increases Immunoglobulin G Production by Affecting Helper T Cell Populations after Antigen Exposure

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Abstract: Whey protein is a by-product of cheese and casein manufacturing processes. It contains highly bioactive molecules, such as epidermal growth factor, colony-stimulating factor, transforming growth factor-α and -β, insulin-like growth factor, and fibroblast growth factor. Effects of whey protein on immune responses after antigen (hemagglutinin peptide) injection were evaluated in rats. Experimental diets were formulated based on NIH-31M and supplemented with 1% amino acids mixture (CON) or 1% whey protein concentrate (WPC) to generate isocaloric and isonitrogenous diets. Rats were fed the experimental diets for two weeks and then exposed to antigen two times (Days 0 and 14). Blood was collected on Days 0, 7, 14, and 21 for hematological analysis. The WPC group showed decreased IgA and cytotoxic T cells before the antigen injection (Day 0) but increased IgG, IL-2, and IL-4 after antigen injection due to increased B cells and T cells. Helper T cells were increased at Days 14 and 21, but cytotoxic T cells were not affected by WPC. WPC may activate adaptive immunity (IgG) against antigen by modulating helper T cells. Bioactive molecules might contribute to the immune-enhancing effects of whey protein concentrate.

Keywords: whey protein concentrate; immunity; rat

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1. Introduction

Living organisms are in constant competition for shared resources necessary for their survival. At the same time, they must protect themselves against threats or harm. All organisms have an innate immune system of defense, but only vertebrates possess T cells and the ability to produce antibodies. Innate immunity is defined as the first line of defense and is an immediate, non-specific response. Adaptive immunity is a highly specific response with immunological memory [1]. Adaptive immunity can be acquired by either natural (infection) or artificial (vaccination) exposure to an antigen. After primary antigen expose, the antigen-presenting cells interact with and influence the activation or suppression and differentiation of immature T cells into cytotoxic T cells (Tc cells) or helper T cells (Th cells). Tc cells kill infected or damaged cells, and Th cells regulate both innate and adaptive immune responses to a specific antigen via cell-mediated immunity and humoral immunity. Th cells activate and induce B cells to undergo clonal expansion into antibody-secreting plasma cells (humoral immunity). Some B cells and T cells become memory cells that rapidly differentiate into effector cells upon further antigen exposure and are responsible for long-term immunity by producing antibodies [2]. Antibodies (immunoglobulins, Igs) are classified into IgA, IgD, IgE, IgG, or IgM based on their biological properties, functional locations, and ability to manage different antigens [3]. IgG provides the majority of antibody-based immunity against pathogens and represents about 75% of the circulating antibody in humans [1]. Thus, non-pharmaceutical means to

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D O A S	JOURNAL OF FUNCTIONAL FOODS	1756-4646	2214-9414	Food Science & Technology ; Nutrition & Die	ELSEVIER	NETHERLANDS
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D O A S	QUALITY ASSURANCE AND SAFETY OF CR	1757-8361	1757-837X	Food Science & Technology	CODON PUBLICATIONS	NETHERLANDS

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D A S	2022	PLANT FOODS FOR HUMAN NUTRITION	0921-9668	PLANT SCIENCES	4.0	21.1	Q1	4.4	20.7	Q1	0.00156	42.9	Q2
D O A S	2022	Journal of Functional Foods	1756-4646	NUTRITION & DIETETICS	5.6	23.3	Q1	5.3	29.0	Q2	0.01588	11.9	Q1
D O A S	2022	Foods	2304-8158	FOOD SCIENCE & TECH	5.2	23.6	Q1	5.5	22.9	Q1	0.03360	4.6	Q1
D A S	2022	PLANT FOODS FOR HUMAN NUTRITION	0921-9668	CHEMISTRY, APPLIED	4.0	28.1	Q2	4.4	22.6	Q1	0.00156	45.9	Q2
D A S	2022	PLANT FOODS FOR HUMAN NUTRITION	0921-9668	FOOD SCIENCE & TECH	4.0	33.5	Q2	4.4	32.7	Q2	0.00156	55.3	Q3
D A	2022	Quality Assurance and Safety of Crops & Foods	1757-8361	FOOD SCIENCE & TECH	4.0	33.5	Q2	2.3	70.8	Q3	0.00061	80.6	Q4
D A S	2022	PLANT FOODS FOR HUMAN NUTRITION	0921-9668	NUTRITION & DIETETICS	4.0	46.0	Q2	4.4	46.0	Q2	0.00156	73.3	Q3