Effects of Dietary Yogurt: Changes in Blood Components on Healthy Men Smokers

Hyun-Kyung Kim, Chang-Oh Kweon, Byung-Won Kim, Soo-Hwan Kim, Jae-Ki Ryu

Department of Biomedical Laboratory Science, College of Nursing and Health Science, Gimcheon University, Gimcheon, Korea

ORIGINAL ARTICLE

ABSTRACT

Smoking is associated with increased inflammation and is a risk factor for a range of diseases. Conversely, yogurt has beneficial effects on health. This study examined the effects of yogurt consumption on the hematological parameters and fibrinogen levels in smokers. The participants were categorized into four groups. Non-smokers were assigned to the control and yogurt groups while smokers were assigned to the smoking and combined (yogurt plus smoking) groups. The participants consumed yogurt, and either smoked or did not smoke for three weeks. The changes in hematological parameters and fibrinogen levels were examined. In the combined group, the proportion of neutrophils and fibrinogen levels increased significantly, whereas the lymphocyte proportion decreased. The eosinophil proportion increased significantly in the Smoking group, but no change was observed in the combined group. In addition, the mean corpuscular hemoglobin concentration increased in the smoking and combined groups, indicating that smoking may affect the lifespan of red blood cells. In conclusion, this study showed that yogurt consumption might influence the immune function by modulating the levels of neutrophils, lymphocytes, and fibrinogen in smokers. Furthermore, the absence of any increase in the eosinophil proportion in the combined group, unlike in the smoking group, suggests that yogurt consumption may have an inhibitory effect on allergic reactions.

INTRODUCTION

Blood is a sensitive marker for various changes that occur in response to physiological and pathological conditions [1], therefore, investigations into hematological changes are critical in the diagnosis of diseases.

Cigarette smoke contains more than 7,000 chemicals, including various oxidizing agents [2]. Smoking is associated with the occurrence of hypertension and inflammation, and is a risk factor for diseases including cancer and cardiovascular diseases [3-5]. Fibrinogen is a plasma glycoprotein that plays a role in the coagulation system. Fibrinogen levels in the blood increases during inflammatory responses, it is a known proinflammatory mediator already used as a marker of arterial thrombosis [1]. Several studies have investigated
the effects of probiotic dairy products on health [6]. Yogurt is a probiotic-containing fermented food product, known to have beneficial effects on health, such as decreasing cholesterol and inflammation, when consumed daily [7, 8]. Yogurt exhibits protective effects in acute lung injury and lung cancer [9, 10]. However, it has been reported that habitual yogurt consumption does not necessarily improve the health-related quality of life [11]. Although studies for effects of cigarette use and yogurt on health have previously been performed separately, to our knowledge our investigation into the effects of yogurt consumption in smokers is rare. Therefore, this study attempts to respond to this gap in the literature by investigating the possible effects of yogurt consumption in smokers, using hematological parameters and fibrinogen levels.

### Table 1. Subject characteristics before study

|                          | Control (N=9) | Yogurt (N=9) | Smoking (N=9) | Combined (N=9) | ANOVA | P-value |
|--------------------------|---------------|--------------|---------------|----------------|--------|---------|
| Age (years)              | 21.9±1.4      | 22.0±1.9     | 21.8±1.9      | 21.6±1.6       | 0.91   |
| Body weight (kg)         | 70.0±16.1     | 73.1±6.5     | 73.6±14.4     | 69.9±13.9      | 0.88   |
| Waist circumference      | 30.8±4.2      | 31.7±2.4     | 30.5±3.4      | 31.4±3.7       | 0.56   |
| Blood pressure (systolic) (mmHg) | 116.4±14.2 | 110.0±13.5   | 123.8±10.2    | 123.8±6.3      | 0.39   |
| Blood pressure (diastolic) (mmHg) | 85.9±4.9    | 84.7±3.9     | 82.3±7.6      | 82.3±7.6       | 0.41   |
| WBC (×10^3/μL)           | 6.5±2.1       | 6.9±0.7      | 7.0±2.1       | 7.4±1.7        | 0.39   |
| Neutro (%)               | 54.0±7.9      | 55.3±5.9     | 56.1±10.4     | 50.4±6.5       | 0.51   |
| Lympho (%)               | 34.1±8.9      | 34.2±5.9     | 33.7±10.6     | 38.4±6.3       | 0.55   |
| Mono (%)                 | 7.8±1.8       | 6.9±1.7      | 7.3±1.0       | 7.8±1.6        | 0.72   |
| Eosino (%)               | 3.3±2.0       | 2.7±2.1      | 2.1±1.1       | 2.7±1.7        | 0.64   |
| Baso (%)                 | 0.8±0.1       | 0.9±0.4      | 0.8±0.5       | 0.7±0.3        | 0.8    |
| RBC (×10^6/μL)           | 5.09±0.39     | 5.25±0.33    | 5.07±0.37     | 5.15±0.26      | 0.83   |
| Hgb (g/dL)               | 15.5±0.8      | 15.9±0.8     | 15.5±0.9      | 15.7±0.7       | 0.69   |
| Hct (%)                  | 44.7±2.0      | 45.9±2.5     | 45.0±3.2      | 45.5±1.6       | 0.85   |
| MCV (fl)                 | 87.9±3.6      | 87.7±2.3     | 88.9±2.4      | 88.5±2.4       | 0.92   |
| MCH (pg)                 | 30.5±1.3      | 30.4±1.0     | 30.7±0.8      | 30.5±0.9       | 0.98   |
| MCHC (g/dL)              | 34.7±0.7      | 34.7±0.4     | 34.5±0.8      | 34.4±0.6       | 0.63   |
| Plt (×10^9/μL)           | 302±59        | 292±24       | 259±35        | 318±57         | 0.06   |
| MPV (fl)                 | 10.4±0.5      | 10.7±0.8     | 11.1±0.7      | 10.2±0.8       | 0.09   |
| Fibrinogen (mg/dL)       | 247.6±57.9    | 198.1±28.1   | 252.9±53.8    | 219.0±12.7     | 0.56   |

Data are mean±SD. The Kruskal–Wallis test was used to compare four groups for statistical analysis. Significance level P<0.05. Abbreviations: SD, standard deviation; WBC, white blood cell; Neutro, Neutrophil; Lympho, Lymphocyte; Mono, Monocyte; Eosino, Eosinophil; Baso, Basophil; RBC, red blood cell; Hgb, hemoglobin; Hct, hematocrit; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; Plt, platelet; MPV, mean platelet volume.

---

### MATERIALS AND METHODS

#### 1. Subjects and duration of research

Healthy males aged between 20 and 26, comprising of 18 non-smokers and 18 smokers and not using any medication, were selected for the study (Table 1). Of the smokers, only those using 10 cigarettes per day were included. This study was conducted for three weeks. Approval was gained from the Institutional Review Board of Gimcheon University (GU-201805-HRBRa-06-02-P), signed informed consent was obtained from all participants.

#### 2. Procedure

These participants were divided into 4 groups: Control (no change to routine), Yogurt (160 g of yogurt added to the daily diet), Smoking (10 cigarettes per day), and Combined (160 g of yogurt plus 10 cigarettes per day): 9 subjects were allocated to each group. The yogurt and combined groups consumed 80 g of yogurt...
twice a day, after breakfast and dinner. Commercialized yogurt contains the bacterial species Lactobacillus bulgaricus, Lactobacillus bifidus, and Streptococcus thermophilus. Before this study began, ethylenediamine tetraacetic acid (EDTA) whole blood samples, for complete blood count (CBC) tests and citrated plasma, for fibrinogen measurements, were collected from the subjects. CBC tests were conducted with Sysmex Xn-9000 (Sysmex, Kobe, Japan) and fibrinogen levels were measured with the STA-R analyzer (Diagnostica Stago, Asnières sur Seine, France). This study was conducted for three weeks. The frequency and nature of diet of four groups remained per usual. The yogurt group consumed 80 g of yogurt twice per day, the smoking group smoked 10 cigarettes per day, and the combined group consumed 80 g of yogurt twice per day, in addition to smoking 10 cigarettes per day. After three weeks, EDTA blood samples were collected and CBC and fibrinogen measurement tests were conducted.

3. Statistical analysis

This study was conducted for 9 participants per group. Therefore, we implemented the Wilcoxon signed rank test, a nonparametric method for paired data. The Kruskal–Wallis test, nonparametric alternative to one–way ANOVA, was used to compare four groups (GraphPad Software, San Diego, CA, USA).

| Table 2. Changes of white blood cells |
|--------------------------------------|
|                                      |
| **WBC (×10³/μL)**                    |
| Pre 6.5±2.1 0.82 6.9±0.7 0.18 7.0±2.1 0.42 7.4±1.7 0.99 |
| Post 6.4±0.9 6.5±0.8 6.5±0.9 7.3±1.9 |
| **Neutro. (%)**                      |
| Pre 54.0±7.9 0.07 55.3±5.9 0.95 56.1±10.4 0.16 50.4±6.5 0.03 |
| Post 49.5±6.2 55.2±6.1 50.0±9.1 54.5±5.0 |
| **Lympho (%)**                       |
| Pre 34.1±8.9 0.16 34.2±5.9 0.95 33.7±10.6 0.43 38.4±6.3 0.02 |
| Post 38.4±7.2 34.1±5.8 38.1±8.4 34.4±4.7 |
| **Mono (%)**                         |
| Pre 7.8±1.8 0.73 6.9±1.7 0.94 7.3±1.0 0.13 7.8±1.6 0.38 |
| Post 7.8±1.6 6.9±1.4 8.3±1.8 7.5±1.8 |
| **Eosino (%)**                       |
| Pre 3.3±2.0 0.86 2.7±2.1 0.29 2.1±1.1 0.02 2.7±1.7 0.78 |
| Post 3.4±2.6 2.9±2.4 2.9±1.4 2.7±1.7 |
| **Baso (%)**                         |
| Pre 0.8±0.1 0.46 0.9±0.4 0.93 0.9±0.5 0.36 0.7±0.3 0.73 |
| Post 0.9±0.2 0.9±0.4 0.7±0.4 0.8±0.2 |

Data are mean±SD. The Wilcoxon signed rank test was used for statistical analysis. Significance level \( P<0.05 \). Abbreviations: See Table 1; Pre, before study; Post, after study.

RESULTS

1. White blood cells

The total number of white blood cells showed no significant change in any of the 4 groups. Total numbers of white blood cells in smokers was higher than that in non-smokers, although this was not significant. The white blood cell differential counts, however, did showed significant changes in the proportion of specific cell groups, for example, neutrophils, lymphocytes, and eosinophils, over the course of the experiment (Table 2). In the combined group, neutrophil levels increased and lymphocytes decreased. The eosinophil number increased in the smoking group, but this increase was not observed in the combined group.

2. Red blood cells

The number of red blood cells showed no significant changes in any of the 4 groups, but in the red blood cell index, the mean corpuscular hemoglobin concentration (MCHC) showed significant increases in both smoking and combined groups (Table 3). The hemoglobin levels were also acquired but had to be discarded for all 4 groups due to change of control group. The CBC tests were performed by an external laboratory; a systematic error may have affected the results of the hemoglobin
Table 3. Changes of red blood cells

|                      | Control (N=9) | P   | Yogurt (N=9) | P   | Smoking (N=9) | P   | Combined (N=9) | P   |
|----------------------|---------------|-----|--------------|-----|---------------|-----|----------------|-----|
| RBC (×10⁶/μL)        |               |     |              |     |               |     |                |     |
| Pre                  | 5.09±0.39     | 0.91| 5.25±0.33    | 0.99| 5.07±0.37     | 0.43| 5.15±0.26      | 0.91|
| Post                 | 5.10±0.34     |     | 5.23±0.29    |     | 5.15±0.29     |     | 5.14±0.26      |     |
| Hgb (g/dL)           |               |     |              |     |               |     |                |     |
| Pre                  | 15.5±0.8      | 0.44| 15.9±0.8     | 0.55| 15.5±0.9      | 0.06| 15.7±0.7       | 0.14|
| Post                 | 15.8±0.9      |     | 16.1±0.9     |     | 16.0±0.7      |     | 16.0±0.6       |     |
| Hct (%)              |               |     |              |     |               |     |                |     |
| Pre                  | 44.7±2.0      | 0.86| 45.9±2.5     | 0.89| 45.0±3.2      | 0.36| 45.5±1.6       | 0.95|
| Post                 | 45.0±2.2      |     | 46.0±2.2     |     | 45.8±2.1      |     | 45.8±1.9       |     |
| MCV (fL)             |               |     |              |     |               |     |                |     |
| Pre                  | 87.9±3.6      | 0.06| 87.7±2.3     | 0.33| 88.9±2.4      | 0.67| 88.5±2.4       | 0.09|
| Post                 | 88.4±3.9      |     | 88.2±2.3     |     | 89.0±2.0      |     | 89.1±1.6       |     |
| MCH (pg)             |               |     |              |     |               |     |                |     |
| Pre                  | 30.5±1.3      | 0.04| 30.4±1.0     | 0.02| 30.7±0.8      | 0.04| 30.5±0.9       | 0.01|
| Post                 | 30.9±1.4      |     | 30.9±1.1     |     | 31.1±0.7      |     | 31.2±0.9       |     |
| MCHC (g/dL)          |               |     |              |     |               |     |                |     |
| Pre                  | 34.7±0.7      | 0.11| 34.7±0.4     | 0.11| 34.5±0.8      | 0.04| 34.4±0.6       | 0.02|
| Post                 | 35.1±0.8      |     | 35.1±0.7     |     | 34.9±0.5      |     | 35.0±0.7       |     |

Data are mean±SD. The Wilcoxon signed rank test was used for statistical analysis. Significance level P<0.05.
Abbreviations: See Table 1; Pre, before study; Post, after study.

Table 4. Changes of platelets

|                     | Control (N=9) | P   | Yogurt (N=9) | P   | Smoking (N=9) | P   | Combined (N=9) | P   |
|---------------------|---------------|-----|--------------|-----|---------------|-----|----------------|-----|
| Plt (×10³/μL)      |               |     |              |     |               |     |                |     |
| Pre                 | 302±59        | 0.43| 292±24       | 0.84| 259±35        | 0.07| 318±57         | 0.12|
| Post                | 310±59        |     | 298±29       |     | 271±26        |     | 334±55         |     |
| MPV (fL)            |               |     |              |     |               |     |                |     |
| Pre                 | 10.4±0.5      | 0.07| 10.7±0.8     | 0.69| 11.1±0.7      | 0.39| 10.2±0.8       | 0.48|
| Post                | 10.6±0.6      |     | 10.9±0.8     |     | 11.2±0.8      |     | 10.1±0.7       |     |

Data are mean±SD. The Wilcoxon signed rank test was used for statistical analysis. Significance level P<0.05.
Abbreviations: See Table 1; Pre, before study; Post, after study.

3. Platelets

Platelet size is known to be related to cardiovascular disease [12]. Therefore, we investigated the effects of yogurt consumption and smoking on platelet number and size. However, no significant changes occurred, in any group, to either the number of platelets or the mean platelet volume (MPV) (Table 4).

4. Fibrinogen

The fibrinogen levels showed significant increase in the combined group only (P<0.05), all other groups showed non-significant changes (Figure 1).

DISCUSSION

The study was conducted to determine if probiotic yogurt, which is known to be beneficial to the human body, could have an effect on the health of moderate smokers. We observed changes in white blood cells, red blood cells, and platelets in the blood, taking place over the course of a three-week study. Our study found that the number of white blood cells in smokers, though not
significant, was higher than in non-smokers, consistent with previous findings [13, 14]. An increase in white blood cells is known to be associated with the occurrence of various diseases [15]. Neutrophils are known to have an innate immune function through phagocytic action [1], thus, a decrease in neutrophils can lead to decreased immune functionality. In a study investigating the effects of cigarettes on neutrophil characteristics, neutrophils exposed to cigarette smoke extract (CSE) were more likely to undergo cell death and to have a compromised ability to ingest pathogens [16]. This corroborates the findings of this study: that smoking affects the number of neutrophils in the blood.

In the combined group, the number of neutrophils increased significantly, whereas lymphocytes showed a significant decrease in number. These results were similar to those of previous studies, for example, Nishimura et al. [17] reported changes in white blood cell number after eight weeks of yogurt intake. They showed that, in the yogurt ingesting group, the neutrophil number increased for up to four weeks, before returning to their initial level. Contrarily, lymphocyte numbers decreased, before recovering at their initial level. The findings of our study, conducted for three weeks, are therefore consistent with the study of Nishimura. Fibrinogen is a known pro-inflammatory protein, increasing the acute-phase of the response. Previous studies have reported that plasma fibrinogen levels increase in smokers [18, 19]. Despite initially predicting to observe a strong increase in fibrinogen in the smoking group, our study showed meaningful increase in the combined group only. Agerholm-Larsen et al suggested that yogurt consumption increases blood fibrinogen levels due to temporary immunostimulation caused by the bacterial strain in the fermented milk product, and reported fibrinogen levels within the normal range and no increase in the CRP [20]. In this study, we found that the increased fibrinogen levels in the combined group were within the normal range. Further, the fibrinogen levels in the yogurt group also increased, however, this change was not significant. The hs-CRP levels in the yogurt and combined groups did not change significantly, and were within the normal range (data not shown). Therefore, it can be suggested that the increase in fibrinogen levels in the combined group was due to a temporary immunostimulation caused by yogurt consumption. A recent study on fibrinogen reported that the protein is associated with the development of the early innate immune system, and works to rapidly block and neutralize invading pathogens [21]. The significant increase in the number of neutrophils, and the level of fibrinogen, in the combined group appears to be a temporary reaction caused by the immunostimulant effects of the bacteria contained in the yogurt, which could indicate that the ingestion of yogurt by smokers could boost the immune response. These results are consistent with those of previous studies which suggest that yogurt increases immune response [22, 23]. The number of eosinophils in the blood increase as a response to allergic reactions or parasitic infections [1]. Some studies have shown that smoking is related to allergy occurrence [24, 25]. Previous studies, investigating Lactobacillus and allergies, have found that Lactobacillus may exhibit protective effects [26, 27]. Our study showed a significant increase in the number of eosinophils in the smoking group, after three weeks, which was not seen in the combined group. This may mean that yogurt can work to suppress allergic responses caused by smoking.

In addition, the red blood cell (RBC) index, showed an increase in MCHC in both the smoking and combined groups. The MCHC is an average concentration of hemoglobin in a RBC. If the surface area of cell decreases relative to the volume, the MCHC increases and the RBC becomes a spherocyte. Spherocytes have reduced deformability, which can easily cause hemolysis and often results in a reduction of cell lifespan. In the previous studies, the MCHC showed a greater increase in anemic-smokers than non-anemic smokers as well as in the smoking group, which appears to be the result of increased carbon...
monoxide presence in smokers, resulting in reduced oxygen supply to tissues [28-30]. Consequently, smoking may cause the decrease of neutrophils, and the increase of lymphocytes, and eosinophils. Yogurt may be able to modulate immune function by promoting an increase of neutrophils, decrease of lymphocytes, and the increase of fibrinogen when smoking. The potential inhibition of eosinophil increase in smokers also showed that yogurt could have a protective function against an allergic response. Smoking was also found to negatively impact the lifespan of RBCs. These results would seem to predict that smokers’ yogurt intake can help control their immune function. There are several limitations to this study, however. The small sample size will, unfortunately, mean we can draw no definitive conclusions. Additionally, the short duration of the study does not enable us to determine the long-term impacts of pro-biotic foodstuffs on the health of smokers, which could be an interesting future project. Further studies may be conducted using larger groups of participants, increasing the study duration, and examining more test parameters. It will be able more information related to yogurt consumption to be attained, and allow the comparison of the effects of yogurt consumption with other lactic acid bacteria. Comparison between light and heavy smokers, and non-smokers, may also be considered.

Acknowledgements: This work was supported by the 2018 Gimcheon University Research Grant.

Conflict of interest: None

Author’s information (Position): Kim HK, Professor; Kweon CO, Professor; Kim BW, Professor; Kim SH, Professor; Ryu JK, Professor.

REFERENCES

1. Rodak BF, Frisma GA, et al. Hematology: Clinical principles and applications. 4th ed. Missouri: Elsevier; 2012. p1-6.
2. Pryor WA, Prier DG, Church DF. Electron-spin resonance study of mainstream and sidestream cigarette smoke: nature of the free radicals in gas-phase smoke and in cigarette tar. Environ Health Perspect. 1983;47:345-355. https://doi.org/10.1289/ehp.8347345
3. Kume A, Kume T, Masuda K, Shibuya F, Yamazaki H. Dose-dependent effects of cigarette smoke on blood biomarkers in healthy Japanese volunteers: Observations from smoking and non-smoking. J Health Sci. 2009;55:259-264. https://doi.org/10.1248/jhs.55.259
4. Nadruz Jr W, Gonçalves A, Claggett B, Querejeta RG, Shah AM, Cheng S, et al. Influence of cigarette smoking on cardiac biomarkers: The atherosclerosis risk in communities (ARIC) study. Eur J Heart Fail. 2016;18:629-637. https://doi.org/10.1002/ejhf.511
5. Liu J, Liang Q, Frost-Pineda K, Muhammad-Kahi R, Rimmer L, Roethig H, et al. Relationship between biomarkers of cigarette smoke exposure and biomarkers of inflammation, oxidative stress, and platelet activation in adult cigarette smokers. Cancer Epidemiol Biomarkers Prev. 2011;20:1760-1769. https://doi.org/10.1158/1055-9965.EPI-10-0987
6. Aryana KJ, Olson DW. A 100-year review: Yogurt and other cultured dairy products. J Dairy Sci. 2017;100:9987-10013. https://doi.org/10.3168/jds.2017-12981
7. Astrup A. Yogurt and dairy product consumption to prevent cardiometabolic disease: epidemiologic and experimental studies. Ann J Clin Nutr. 2014; 99:5 Suppl:1235-1242. https://doi.org/10.3945/ajcn.113.137035
8. Asemi Z, Jazayeri S, Najafi M, Samimi M, Mofid V, Shidfar F, et al. Effects of daily consumption of probiotic yogurt on inflammatory factors in pregnant women: a randomized controlled trial. Pak J Biol Sci. 2011;14:475-482. https://doi.org/10.3923/pjbs.2011.
10. Yang JJ, Yu D, Xiang YB, Blot W, White E, Robien K. Association of dietary fiber and yogurt consumption with lung cancer risk: A pooled analysis. JAMA Oncol. 2019;5:1941. https://doi.org/10.1001/jamaoncol.2019.4107

11. Lopez-Garcia E, Leon-Muñoz L, Guallar-Castillon P, Rodríguez-Artalejo F. Habitual yogurt consumption and health-related quality of life: A prospective cohort study. J Acad Nutr Diet. 2015;115:31-39. https://doi.org/10.1016/j.jand.2014.05.013

12. Chu SG, Becker RC, Berger PB, Bhatt DL, Eikelboom JW, Konkle BA, et al. Mean platelet volume as a predictor of cardiovascular risk: a systematic review and meta-analysis. J Thromb Haemost. 2010;8:148-156. https://doi.org/10.1111/j.1538-7836.2009.03584.x

13. Jung ES, Shim HM, Cho DS, Choi JT. The relationship between smoking status and a high white blood cell count. Korean J Fam Med. 1994;15:208-217.

14. Ahmed OA. Effects of smoking cigarette on white blood cell and platelet parameter on sample of normal subject in Rania city. Imp J Inter discip. Res. 2016;2:887-892.

15. Grimm RH Jr, Neaton JD, Ludwig W. Prognostic importance of the white blood cell count for coronary cancer and all-cause mortality. JAMA. 1985;254:1932-1937. https://doi.org/10.1001/jama.1985.03360140090031

16. Guzik K, Skret J, Szuajur B, Bzowska M, Gaślowska B, Scott DA, et al. Cigarette smoke-exposed neutrophils die un conventionally but are rapidly phagocytosed by macrophage. Cell death Dis. 2011;2:E131. https://doi.org/10.1038/cddis.2011.13

17. Nishimura M, Ohkawara T, Tetsuka K, Kawasaki Y, Nakagawa R, Satoh H, et al. Effects of yogurt containing Lactobacillus Plantarum L 6 7 and its application to yogurt. J Tradit Complement Med. 2016;6:275-280. https://doi.org/10.1016/j.jtcm.2015.07.003

18. Meade TW, Imeson J, Stirling Y. Effects of changes in smoking and other characteristics on clotting factors and the risk of ischaemic heart disease. Lancet. 1987;2:586-588. https://doi.org/10.1016/0140-6736(87)92556-6

19. Cho HM, Kang DR, Kim HC, Oh SM, Kim BK, Suh J. Association between fibrinogen and carotid atherosclerosis according to smoking status in a korean male population. Yonsei Med J. 2015;56:921-927. https://doi.org/10.3349/ymj.2015.56.4.921

20. Agerholm-Larsen L, Raben A, Haulrik N, Hansen AS, Manders M. Astrup A. Effects of 8 week intake of probiotic milk products on risk factors for cardiovascular diseases. Eur J Clin Nutr. 2000;54:288-297. https://doi.org/10.1038/sj.ejcn.1600957

21. Puhlman LI, Mingelin M, Kasgert G, Olin AI, Schmidtchen A, Harwald H. Antimicrobial activity of fibrinogen and fibrinogen-derived peptides—a novel link between coagulation and innate immunity. Thromb Haemost. 2013;109:930-939. https://doi.org/10.1160/TH12-10-0739

22. Miyazaki S, Ha WK. Immunologic effects of yogurt. Am J Clin Nutr. 2000;72:861-872. https://doi.org/10.1093/ajcn/71.4.861

23. Lollo PCB, Soaresde Moura C, Morato PN, Cruz AG, Castro WF, Betim CB, et al. Probiotic yogurt offers higher immune-protection than probiotic whey beverage. Food Res Int. 2013;54:118-124. https://doi.org/10.1016/j.foodres.2013.06.003

24. Saylyte F, Artalejo F. Habitual yogurt consumption and health-related quality of life: A prospective cohort study. J Tradit Complement Med. 2016;6:275-280. https://doi.org/10.1016/j.jtcm.2015.07.003

25. Lee A, Lee SY, Lee KS. The use of heated tobacco products is associated with asthma, allergic rhinitis, and atopic dermatitis in korean adolescents. Sci Rep. 2019;9:17699. https://doi.org/10.1038/s41598-019-54102-4

26. Lee NK, Kim SY, Han JK, Eom SJ, Paik HD. Probiotic potential of Lactobacillus strains with anti-allergic effects from kimchi for yogurt starters. LWT-Food Sci Technol. 2014;58:130-134. https://doi.org/10.1016/j.lwt.2014.02.028

27. Song SY, Lee SJ, Park DJ, Oh SJ, Lim KT. The anti-allergic activity of Lactobacillus Plantarum H167 and its application to yogurt. Dairy Sci. 2016; 99:9372-9382. https://doi.org/10.3168/jds.2016-9372.

28. Arora S, Yadav K, Kaul N. Hematological changes induced by cigarette smoking: study of patients visiting different outpatient departments of integral institute of medical science and research, lucknow. Natl J Physiol Pharm Pharmacol. 2020;10:149-154. https://doi.org/10.5455/njpfp.2019.1041285123019

29. Billo YY. Effects of cigarette smoking on blood rheology and biochemistry. Int J Sci Res. 2015;4:107-112.