Establishment of a model for examining the improving effects of meat components against brain dysfunction

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Objectives: The International Agency for Research on Cancer has reported that the intake of red meat and processed meat increases the risk of developing cancer. However, an epidemiologic study of elderly subjects suggested an increased risk of dementia and Al- zheimer's disease in the group with reduced only low meat consumption (<1 time/week) compared to the group with regular consumption (≥ 4 more/week) [1]. Furthermore, in an epidemiological study of vegetarians, Vegetarians had more depressive symptoms compared with omnivores [2]. In addition, meat contains several ingredients that improve brain function. For example, carnosine contributes to improved cognitive function mediated by the antioxidative effect. In this way, dietary intake of meat products can be expected to prevent the decline in brain function. Thus, it should be verified whether meat intake affects the decline of brain function and the relief of brain dysfunction.

Brain dysfunctions such as dementia and depression are consistently increasing worldwide. Aging reduces the function of antioxidant enzymes and causes oxidative stress. This oxidative stress increases the risks of deterioration of brain function and the development of brain dysfunction. Therefore, it is necessary to establish preventive and therapeutic methods against brain dysfunction induced by oxidative stress.

However, there is no appropriate model to evaluate the effects of oxidative stress on brain function. Therefore, the objective of the present study was to establish an animal model of brain dysfunction induced by oxidative stress to examine the effects of meat products.

Methods: Oxidative stress was induced by 7 days of administration of scopolamine. Each behavioral test was performed 24 hours posterior to the scopolamine administration. The Barnes maze test, Y-maze test, and Forced swimming test were applied to evaluate the cognitive function (recollection), locomotor activity, and depressive-like behavior, respectively. In the Barnes maze test, the training period for 4 days, the interval period for 7 days, and the main trial consisted of a series behavioral test for cognitive function. The training period allowed mice to explore the maze for 3 minutes and measured the time to reach the escape box as an index of learning. In the main trial, mice were allowed to explore the maze for 5 minutes without the escape box. The exploratory latency around the hole where the escape box had been installed was measured as an index of recollection. In the Y-maze test, the number of times that mice entered each arm was measured as an index of locomotor activity. In the forced swimming test, mice were placed in an acrylic cylinder filled with 25℃ water at a depth of 15 cm heigh for 6 minutes. The immobility time of mice in the cylinder was measured as an index of depression-like behavior. The hippocampus was collected 24 hours after the last behavioral test was carried out for transcriptome analysis.

Results and Discussion: In the Barnes maze test, there was no significant difference in the time to reach the escape box. However, the scopolamine treatment significantly reduced the exploratory latency around the hole where the escape box. In the Y-maze test, there was no significant difference in the number of entries to each arm. In the forced swimming test, the scopolamine treatment significantly increased the duration of immobility. The present results demonstrated that cognitive dysfunction (recollection dys- function) and depressive-like behavior were induced by chronic scopolamine administration. Memory function is composed of three faculties: learning(consolidation), retention, and recollection. In the present study, the learning should not have been damaged because of no scopolamine administration during the training period. However, recollection dysfunction was induced by the administration of scopolamine during the interval period. Therefore, the present result was demonstrated to be an impaired model focusing on recollection. Transcriptome analysis showed activation of signaling pathways involved in inflammation, such as Inflammatory response, Cytokine secretion, and lnterleukin-2 production. In addition, oxidative stress accumulates in the model and induces brain dysfunction via neuroinflammation.

In the conclusion, the present study indicates that the established animal model of recollection dysfunction and depressive-like symptom is induced by accumulated oxidative stress via neuron inflammation. This model may mimic the brain dysfunction induced by aging. In the future, we will examine the effects of meat products containing carnosine with the antioxidant and antidepressant-like effects and taurine with antidepressant-like effect for improving and preventing brain dysfunction. Conducting these studies will suggest the importance of dietary meat in the elderly.

Reference:

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