

HEALTH AND NUTRITION NEWS

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Prefatory Note

Development of applied nutrition for human health

Teiji Nakamura, PhD, RD.

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President, The Japan Dietetic Association



“How should we choose foods, and how much can we take them, so that we can have healthy and happy life?” This is a simple question, but is an origin of nutrition sciences and still a base of research objectives. Fortunately, humans beings discovered “nutrients” and have explored the methods to investigate the associations between diets and vital activities scientifically. In addition, the roles of nutrients and recommended intakes were explored and some nutrients were synthesized. Now, it is possible not only to provide the scientifically acknowledged appropriate diet, but also to supply our bodies directly with each nutrient.

Some time ago, I listened to the performance by a pianist whose intestine had been resected due to the Crohn’s disease, and that he has not taken any foods by mouth for about 10 years. Now, it is possible to take necessary energy and all the nutrients, beyond the limits of appetite and capacity of taking foods. Yet, from our experiences, we know that the patients became lively and talkative with more smiles, once they restart to take foods by mouth, even very small amount only. Neither their nutritional intake reach the required amounts nor the results of physical examination are improved, but apparently, the patients become better.

I used to work for a hospital and am now engaged in education and research at a university from 3 years ago. At the present university, there are four Schools; School of Nutrition & Dietetics, School of Nursing, School of Social Welfare and School of Rehabilitation. Our mission is to carry on the human services in collaboration with these Schools, by removing barriers among them. I have been seeking what the nutrition sciences should be, by discussing with staffs of other Schools. Since the nutrition sciences have the universal materials called “nutrients”, it is scientifically well systematized. I am anxious, however, that this may make us to disregard the

original purposes of “for human beings”. On the other hand, other Schools would accumulate the studies on the methods to relieve the pains and disease burdens of injured/sick persons in order to theorize them. None of these Schools has a material like “nutrients”, and they would totally target humans. Although these fields are not neatly systematized as the nutrition sciences, they never turn from humans.

On the other hand, in the field of nutrition sciences, the association between foods/nutrients and human life behavior are theorized, and then, the systematized principles are applied in the clinical field. The priorities of nutritional specialists are the principles of nutrition sciences, and thus, the basic researches to explore them are well emphasized, whereas the practical researches to seek for the methodologies to solve the actual contradictions/problems tend to be neglected. In the education for dietitians/registered dietitians, they are trained to apply the nutrition sciences in the practical field, following the principles strictly. However, when we treat the injured/sick persons individually, we often get embarrassed to see the complexity and variability of humans. This could be more complex, when we take into account of, not only the health and nutritional status of each patient, but also his/her view of life and daily life.

With the revision of long-term care insurance system in Japan, the registered dietitians are now able to meet and work directly with each patient at bed side. I expect that, from now on, the nutrition researches that reflect the opinions from the field will be enhanced.

The NIHN has been historically a core of the nutrition researches in Japan, as well as a base for the nutritionists. In order to respond to the nutritional/dietary problems among human beings, I expect that the collaboration and partnership between the NIHN and dietitians would further develop hereafter.

** The original Japanese version was translated by
Office for International Collaboration, NIHN*

Current Research Projects

Laboratory of Informatics on Health and Nutrition

Kouichi Hirota

Division of Health Informatics and Education

Now, it is quite easy to search information on the web, mainly due to the improvement of algorithm used in the program of search sites. I guess everybody has heard of the search site “Google” (<http://www.google.co.jp>). The algorithm used in this site was developed in 1998, which dramatically changed the internet search. It should be difficult to imagine, but the site search before 1998 was literally “mountain in labor” accompanying lots of efforts with little outcomes.

Here, our Laboratory works on the researches to search and organize the health and nutrition information effectively on the web.

I myself have been involved in these researches since 1995, before the present Laboratory was established. Since the internet search environment was poor at that time, the main focus was to develop the algorithm to search the useful sites. In 2001 when this Laboratory was established, however, it was no longer important to search just useful information because the “Google” had been launched some years before. In addition, the websites of international academic journals established the system to browse the PDF version of articles. We therefore started the researches on the system to collect and browse the latest research findings from the scientific information sites. Later, the following functions were added to the above system; machine translation system, automated information collection from France, Germany, Italy, Spain, Korea and China, and daily automated collection of the latest articles on health foods from the database of National Library of Medicine. The outputs of this system can be seen in our website: <http://humpty.nih.go.jp> (Japanese only)

In addition, we also undertake the researches on the reliability of internet information.

The search sites, like Google, are now more user-friendly than the past ones in 20th century. Yet, it must be noted that the basis of this search algorithm is a kind of popularity polls. So, the sites with more access are higher in the search rank.

However, we can not say that the popular sites have fewer mistakes than unpopular ones. It is possible that they might be popular by the false information written in their sites.

While our survey found that there is a definite relation between the standard of site reliability and the scientific reliability of nutrition information, there are also some exceptional cases. The most accurate evaluation method of site reliability is to be checked by the experts, though it is not unrealistic with respect to the scale of websites and speed of development.

Assuming that transmitting only reliable information could improve the reliability of website, we have been working on the development of web systems in collaboration with other Divisions at the NIHN (e.g. Information system on safety and effectiveness for health foods). There are also other tools like the nutrition education tool of “Self-learning system for improving lifestyle habits” and “Nutrition Kids” for children. Since these tools are currently under development, we expect to introduce them more in details later on.



Thoughts on Health and Nutrition Research

Reference Exercise and Physical Activity Quantity (REPAQ) for Health Promotion ~ Physical activity, exercise and fitness ~

Izumi Tabata

Division of Health Promotion and Exercise

Ministry of Health, Welfare and Labour reviewed the “Recommended exercise Allowances for health promotion” in 2005, after 16 years of enactment in 1989, and established the “Reference Exercise and Physical Activity Quantity (REPAQ) for Health Promotion ~ Physical activity, exercise and fitness~” for the nations aged 20-69 years to define the recommended physical activity/exercise level. As described below, the recommended levels are now set as “23 METs · hour per week”¹⁾ for physical activity and “4 METs · hour per week”¹⁾ for exercise.

In order to establish these values, a systematic review of the international/domestic articles was done to identify the physical activity/exercise level and physical fitness (Vo_2 max) that would

significantly reduce the risk of developing diabetes, hypertension and ischemic heart diseases.

As for Vo_2 max (an index of the endurance), the average values in Japanese were employed as the standard ones. In addition, the qualitative standard was used for muscle strength, that is, “approximate average values”. “Exercise guidelines for health promotion” for the nations as well as the guidebook for the instructors were also prepared, which will be used for the trainings on physical activity and exercise as a part of health activities in the next five years.

And, the educational activities for the nations are going to be implemented from this year.

1) For each activity/exercise, time for 1 unit is defined, and the target units are shown as the total sum during a week

Reference Exercise and Physical Activity Quantity (REPAQ) for Health Promotion ~ Physical activity, exercise and fitness~ (Summary draft)

Office for Lifestyle-related Diseases Control
General Affairs Division, Health Service Bureau
Ministry of Health, Welfare and Labour

We reviewed the “Recommended exercise allowances for health promotion, and defined the ideal levels of the physical activity and exercises for the nations aged 20-69 years. For the persons who attempt for health promotion mainly by the physical activity, the target should be 8,000-10,000 steps daily, and for those who attempt for it mainly by exercise, running or tennis for 35 min/week or quick walking for one hour can be recommended.

1. This report was made by the preparation panel for the recommended exercise allowance and exercise guideline established on 8 August 2005, with the basis of the “Recommended exercise allowances for health promotion (1989)” to which the presently available scientific evidences were added.
2. The main differences from the previous “Recommended exercise allowances for health promotion (1989)” are; 1) standard values are shown for each of physical activity/exercise level and physical power (Vo_2 max) based on the systematic review of international/domestic articles, 2) associations between the lifestyle-related diseases control and physical fitness (including muscle strength) were also investigated.
3. The newly defined standard values of physical activity/exercise level for health promotion are;
 - a. For physical activity: 23 METs · hour/week (Activities with intensity \geq 3METs should be done for 60 minutes/day. If most of the activities are related to walking, the corresponding level is about 8,000-10,000 steps daily)
 - b. For exercise: 4 METs · hour /week (e.g. quick walking for about 60 minutes, running/tennis for 35 minutes).
4. Standard values of Vo_2 max (ml/kg/min) for health promotion, according to gender and age group.

	20-29 years	30-39 years	40-49 years	50-59 years	60-69 years
Male	40	38	37	34	33
Female	33	32	31	29	28

5. This report briefs the associations between health and physical activity/fitness based on the scientific evidences. In order to accumulate new knowledge, it is necessary to promote the related researches to revise the report regularly.

Correlation between amount of Curcumin intake and its Physiological effects.
Junichi Nagata (Division of Food Science)

Termeric is at the top in sales rank of so-called health foods in Japan, and is well known as one of the representative health foods. It is a kind of *Zingiberacea*, a perennial plant, and grows in tropic and subtropic regions, centering on the southeast Asia. It is said that there are about 50 species of termeric in the world. Of which, *Curcuma longa* (*ukon*), *Curcuma aromatica* (*kyouou*) and *Curcuma zedoaria* (*gajyutsu*) are the representative ones in Japan (**Figure 1**). The root tuber and rootstock are the foods related to “*ishoku dogen* (=taking foods in a healthy way for better health)”, which have been used as a dyestuff, spice, Chinese herbal medicine and ancient Indian medicine since the ancient times. They came first to *Ryukyu* (=Okinawa) from China during the *Heian* period (795-1185), and spread gradually across the country. Since then, many experiences on the effects of termetic have been orally handed down to the generations, including the improved liver function, maintenance of stomach and increased bile acid secretion.

Termeric consists of various components such as minerals (P, Fe, Ca, K, Mg), dietary fiber, curcumin (turmeric), curcumen, azulene, camphor and cineole. In particular, the curcumin content of *Curcuma longa* was 3-5%. Curcumin was deemed to be the representative active component that would contribute to the antioxidative function and improvement/maintenance of liver function.

In this study, focusing on curcumin, we investigated the associations between amount of curcumin intake and its effectiveness and safety on rats. Male Wistar rats were fed the experimental diets containing 0.5mg (x1), 5mg (x10), 50mg (x100) curcumin per 100g body weight for 28 days, while the control group received the curcumin-free diets. The basal daily amount of curcumin in rats was estimated by weight conversion based on the recommended daily intake for humans. And, the physiological effects on indices of liver function, serum and liver lipid profiles and other biochemical parameters were examined.

Serum HDL-cholesterol concentrations of rats fed curcumin diets were significantly higher ($p < 0.05$) than that of control group. As for serum TG concentration, it decreased significantly in a curcumin dose-dependent manner (**Figure 2**). On the other hand, there was no significant effect on growth and indices of liver function. In conclusion, this study explored that curcumin was the component that would effectively improve the serum lipid profiles.

Since turmeric consists of various other components, it is still unclear how much of the physiological effects of turmeric are actually derived from curcumin. There remain lots to be investigated on the effectiveness and safety of turmeric, and further studied will be necessary to investigate these mechanisms hereafter too.



Figure 1. *Curcuma longa* (left), *Curcuma aromatica* (center) and *Curcuma zedoaria* (right)

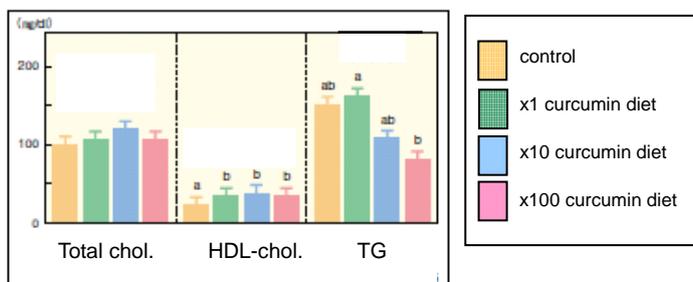


Figure 2. Serum lipid profiles of rats maintained on different curcumin diets

Evaluation of the Correlation Between Amount of Curcumin Intake and its Physiological Effects in Rats

Food science and technology research. 2005;11(2):157-160.

Nagata J and Saito M

Division of Food Science, National Institute of Health and Nutrition, Tokyo, Japan.

Abstract: We examined the correlation between amount of curcumin intake and its physiological effects on indices of liver function, serum and liver lipid profiles in rats. Animals were fed diets containing 0.5, 5 and 50mg curcumin per 100g body weight for 28 days.

HDL-cholesterol concentrations of rats fed curcumin diets were significantly higher ($p < 0.05$) than those of the control group, and serum TG concentration of rats fed the x100 curcumin diets was significantly lower ($p < 0.05$) than that of the x1 curcumin group. Serum TG concentration of rats fed curcumin diets tended to decrease in a curcumin dose-dependent manner. These results indicate that curcumin intake can improve serum lipid profiles effectively.

Latest Research

Effect of dietary factors on incidence of type 2 diabetes: a systematic review of cohort studies.

Kentaro Murakami, Satoshi Sasaki (Project of Scientific Evaluation of Dietary Reference Intakes)

Now, it is estimated that there are at least 6.8 million people with type 2 diabetes in Japan. Since it is quite difficult to treat diabetes completely, the primary prevention of the disease is of significant public health importance. Although many lifestyle related factors are associated with the development of type 2 diabetes, food and nutrition may also play an important role in its cause. We, therefore, systematically reviewed the published cohort studies examining the effects of dietary factors on the incidence of type 2 diabetes, so as to compile the currently available scientific evidences.

The MEDLINE (PubMed) was used to search the articles. The following keywords were used; (“diet” OR “dietary” OR “nutrient” OR “consumption” OR “intake”) AND (“diabetes” OR “diabetic”) AND (“prospective” OR “follow-up”). Of the retrieved articles and their reference lists, only articles that met all the following criteria were identified: 1) the endpoint was the incidence of diabetes; 2) follow-up procedure and length and the definition of the incidence of diabetes were clearly documented; 3) quantitative (including consumption frequency) assessment of food and/or nutrient was conducted; 4) results were shown using the relative risk (RR) (and 95% confidence interval (CI)); and 5) factors used when calculating multivariate RR were clearly indicated.

As a result, 15 individual cohort studies (31 articles) were retrieved, all of which were carried out in Western Countries (10 studies in USA, 3 in Finland, 1 in Netherlands and 1 in Sweden). The number of subjects (n=895-85,060), follow-up length (5.9-23 years), the number of diabetes cases (n=74-4,085), dietary assessment instrument used (simple food questionnaire, food frequency questionnaire, food frequency interview, diet history interview and 24-h recall methods), procedures for ascertaining of the incidence of diabetes (questionnaire, oral glucose tolerance test, fasting glucose level, death certificate, nationwide registry) varied among articles. A total of 99 dietary factors were examined in the 31 articles.

Table 1. Summary table of 15 cohort studies: nutrient and food with preventive/promoting effects

	Total number of study	Significant association
Preventive factor		
a. Nutrient		
Vegetable fat	6	3
Polyunsaturated fatty acid	6	2
Dietary fiber	6	3
Cereal fiber	8	6
Magnesium	8	4
Caffeine	2	2
b. Food and food group		
Grain	3	3
Whole grain	4	3
Coffee	8	5
Promoting factor		
a. Nutrient		
Trans fatty acid	4	2
Heme iron	2	2
Glycemic index	3	2
Glycemic load	4	2
b. Food and food group		
Processed meat	2	2

Table 1 shows the nutrients and foods/food groups for which the preventive or promoting effects of type 2 diabetes were shown in more than 2 articles.

For the evidence-based primary care and treatment of type 2 diabetes, a systematic collection of the previous scientific papers on human studies, and its efficient application are essential. This study, therefore, employed the systematic review to collect and evaluate the articles systematically, where the inclusion criteria were developed to avoid an biased collection of relevant articles. The systematic review is very useful, because a review article enables us to objectively understand the concerned field to some extent, though its usefulness is not yet well acknowledged in Japan.

The present systematic review revealed that the available cohort studies on the association between dietary factors and type 2 diabetes were quite limited. While it can be pointed that some nutrients/foods are associated with the development of diabetes, its scientific evidence is still insufficient. In addition, all 15 studies reviewed in this paper were conducted in Western countries; thus, it is important to examine dietary factors in relation to type 2 diabetes among Japanese populations.

Effect of dietary factors on incidence of type 2 diabetes: a systematic review of cohort studies.

Journal of Nutritional Science and Vitaminology. 2005;51: 292-310

Murakami K¹⁾, Okubo H²⁾ and Sasaki S²⁾.

1) Department of Food and Nutritional Sciences, Graduate School of Nutritional and Environmental Sciences, University of Shizuoka, Shizuoka, Japan

2) Project of Scientific Evaluation of Dietary Reference Intakes, National Institute of Health and Nutrition, Tokyo, Japan

Abstract: We systematically reviewed cohort studies on the effect of nutrient and food intake (except for alcohol) on the incidence of type 2 diabetes, which had been published in English as of May 2004. Using the MEDLINE (PubMed) database as well as reference lists of searched papers, 15 individual cohort studies (a total of 31 papers) were identified. The number of subjects (n= 895-85,060), follow-up length (5.9-23 y), the number of diabetes cases (n= 74-4,085), dietary assessment method used (simple food questionnaire, food frequency questionnaire, food frequency interview, diet history interview, and 24-h recall), and method of case ascertainment (questionnaire, oral glucose tolerance test, fasting glucose level, death certificate, and nationwide registry) varied among studies. For nutrients, intakes of vegetable fat, polyunsaturated fatty acid, dietary fiber (particularly cereal fiber), magnesium, and caffeine were significantly inversely correlated and intakes of trans fatty acid and heme-iron, glycemic index, and glycemic load were significantly positively correlated with the incidence of type 2 diabetes in several papers. For foods and food groups, several papers showed significantly decreased risk for type 2 diabetes with the higher consumption of grain (particularly whole grain) and coffee, and significantly increased risk with processed meat consumption. Because all the studies were carried out in Western countries, however, research in non-Western countries including Japan is needed.

Latest Research

An association between Histidine intake and energy intake: a cross-sectional study in Japanese female students aged 18 years.

Hitomi Okubo, Satoshi Sasaki (Project of Scientific Evaluation of Dietary Reference Intakes)

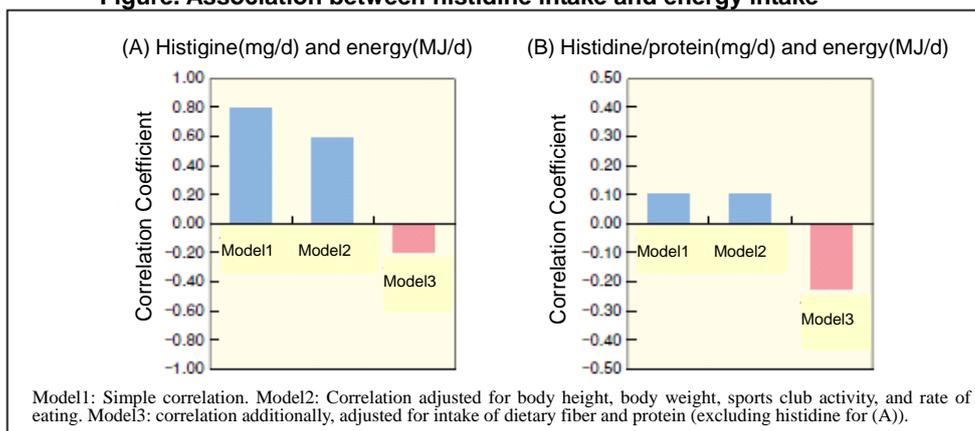
Many people would like to know the answer of “What kind of foods should we take to suppress appetite, so that we can lose weight?”. Well, histamine can be a candidate substance to suppress appetite. Recently, it has been hypothesized that L-histidine (histidine), an essential amino acid, might also control food intake. Although the available evidence in animal studies strongly suggests the effect of histidine on food intake, few human studies have been undertaken so far.

This study therefore examined the association between dietary histidine and energy intake among 1,689 Japanese female students aged 18 years, who entered dietetic courses in April 1997. Two questionnaires were used in this study; one is a self-administered diet history questionnaire (DHQ) to assess dietary habits in the previous one month, and the other is the questionnaire designed to assess the lifestyle variables. In order to assess the effects of daily histidine intake on energy intake, the multiple regression analysis was performed. Here, we must be cautious that gender, body height, body weight and physical activity level could also affect energy intake. In this analysis, therefore, we adjusted for these confounding factors, in order to examine the association between daily histidine intake and energy intake more precisely.

Firstly, a simple regression and correlation analysis was performed, which showed the positive correlation between histidine intake and energy intake (Model 1, **Figure A**). Next, it was adjusted for non-dietary factors such as body height, body weight, physical activity level, rate of eating, and this Model also showed the positive correlation (Model 2, **Figure A**). However, after additional adjustment for dietary factors, such as total dietary fiber and protein excluding histidine, histidine intake turned to show a negative correlation with energy intake (Model 3, **Figure A**). Similar trend was observed when histidine/protein ratio was used for the analysis, instead of crude histidine intake (**Figure B**). In conclusion, our findings from a large and homogeneous sample suggested that dietary histidine might have a suppressive effect on energy intake in human.

Yet, our message from this study is that, rather than the findings itself, the effects of confounding factors in human studies are such a significant, enough to reverse the observed results. This is because that, contrary to animal studies, it is quite difficult to undertake the human studies under the equal conditions. Future epidemiologic studies with better study designs are warranted to examine the role of dietary histidine in energy intake in human.

Figure. Association between histidine intake and energy intake



Histidine intake may negatively correlate with energy intake in human: a cross-sectional study in Japanese female students aged 18 years.

Journal of Nutrition Science and Vitaminology. 2005;51:329-334

Okubo H and Sasaki S

Project of Scientific Evaluation of Dietary Reference Intakes, National Institute of Health and Nutrition, Tokyo, Japan.

Abstract: L-Histidine (histidine), a precursor of neuronal histamine, has recently been hypothesized to suppress food intake. The association between dietary histidine and energy intake was examined among 1,689 Japanese female students of dietetic courses aged 18 y. Nutrient intakes were assessed over a 1-mo period with a validated, self-administered, diet history questionnaire. Both intake of histidine and the ratio of histidine to protein (histidine/ protein) statistically and positively correlated with energy intake. After adjustment for potential non-dietary confounding factors, including body height, body weight, physical activity level, and rate of eating, both the histidine intake and histidine/protein ratio statistically and positively correlated with energy intake (Pearson's correlation coefficient, $r=0.62$ and 0.12 , respectively, $p<0.001$). Moreover, when protein or protein excluding histidine was additionally included into the covariates in order to minimize the effect of dietary factors and other amino acids, both histidine intake and histidine/protein ratio turned out to show a statistically negative correlation with energy intake ($r=-0.22$ and -0.23 , respectively, $p<0.001$). Considering the influence of unavoidable various covariates, we found an inverse association between histidine/protein ratio and energy intake among the young female Japanese students.

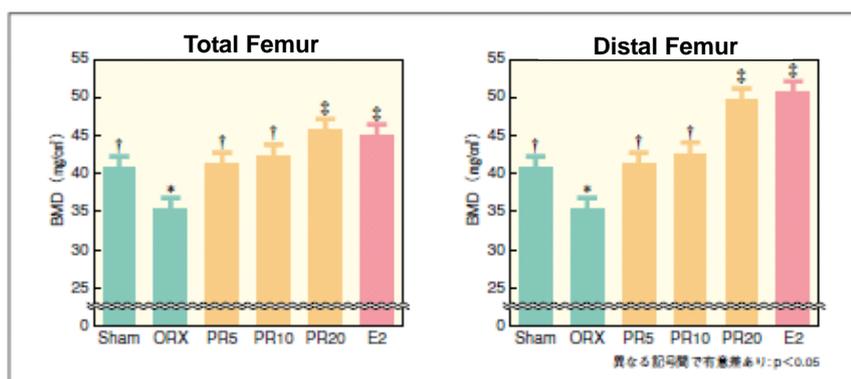
Latest Research

Puerariae radix prevents bone loss in castrated male mice

Yoshiko Ishimi (Division of Applied Food Research)

With advent of the aging society, the increased prevalence of osteoporosis became a significant public health problem. Osteoporosis is a skeletal disorder characterized by compromised bone strength, in terms of both bone mineral density and bone quality, which predisposes a person to the increased risk of fracture. It is reported that about half the Japanese women experience the bone fracture associated with osteoporosis in their lifetime. Likewise, male also suffer from this disorder, due to the reduction of androgen secretion and aging. According to an epidemiological study, about 20% of males aged over 75 years develop osteoporosis. While the sex hormone regulating bone turnover of adult males is mainly androgen, a recent study explored that estrogen also played an important role in regulating the male skeleton. For example, men with genetic defect of estrogen receptor, as well as those with defect of enzyme necessary to produce estrogen from androgen, would develop osteoporosis.

We have been working on the nutritional researches on the prevention of osteoporosis. In previous studies, we have reported that soybeans isoflavones (genistein) prevented bone loss caused by androgen deficiency in male osteoporotic animal models. Isoflavonoids are also included in *Puerariae radix* (PR) (its root is classified as "medicine" and its seeds, leaves, flower and kudzu starch are classified as "food"). Isoflavone content in PR was 10mg/g, five times as high as the one in soybeans. In Japan, PR is commonly taken as herbal medicine to treat the common cold etc., though little is known about the effects on bone. In this study, therefore, we investigated the effects of PR on the bone metabolism in osteoporotic model mice, and the results of male mice are as below; Firstly, male mice were orchidectomized (ORX) and fed a diet containing 5% to 20% of PR for 4 weeks, after which bone mineral density (BMD) of femurs were analyzed by DXA. The whole femoral BMD was significantly lower in ORX mice, though its decrease in BMD was completely prevented by intake of the diet with 5% PR. It is notable that the BMD in the PR group was obviously higher compared with the sham-operated group, and this value was the same level as in the E₂ group. When the site-specific effect of PR was examined, the effect was most strongly observed in the distal region, which consists of trabecular bone (**Figure**). On the other hand, there



was no significant effect on the body weight or on other organs. In conclusion, this study explored that the intake of PR would prevent bone loss in ORX mice. Now, we expect that you could consider your own bone health and the prevention of osteoporosis, when you take *kudzu-mochi* (a kind of Japanese sweets made of kudzu) or *kudzu-yu* (hot drink with kudzu powder). Please contact us if you would like to have the information on the above patent application.

Puerariae radix prevents bone loss in castrated male mice.

Metabolism, 2005; 54:1536-1541

Wang X, Wu J, Chiba H, Yamada K and Ishimi Y.

Division of Applied Food Research, National Institute of Health and Nutrition, Tokyo, Japan

Abstract: *Puerariae radix* (PR) is one of the earliest and most important crude herbs used in Chinese medicine for various medicinal purposes. PR contains a high amount of isoflavonoids, such as daidzein and genistein, which are known to prevent bone loss induced by estrogen deficiency. We have demonstrated that PR not only completely prevents bone loss but also significantly increases the bone mass at high doses in ovariectomized mice without exhibiting estrogenic action in the uterus. In this study, we examined whether PR exhibits effects on bone loss in androgen-deficient male mice similar to estrogen-deficient female mice. Male mice were orchidectomized (ORX) and fed a diet containing low, middle, and high doses (5%, 10%, and 20% of diet, respectively) of PR or normal diet with subcutaneous administration of 17 β -estradiol (E₂), 0.03 microg/d; Sigma, St Louis, Mo), for 4 weeks. In ORX mice, the seminal vesicle weight decreased markedly, and it was not affected by the administration of any doses of PR and E₂. The bone mineral density (BMD) of the whole femur was significantly decreased by ORX, and the decrease in BMD was completely prevented by intake of the diet with the low dose of PR. Intake of the diet with the middle dose of PR further normalized BMD in ORX mice. Furthermore, the high dose of PR administration (PR20) significantly increased BMD in ORX mice, and the potency was similar to that of E₂. Morphometric analysis of the femoral metaphysis showed that intake of the diet with the low dose of PR completely prevented the decrease in bone volume/tissue volume and trabecular number and restored the increase in trabecular separation in ORX mice. In addition, intake of the diet with the high dose of PR further increased bone volume/tissue volume and trabecular number and decreased trabecular separation in ORX mice. These results propose the possibility that estrogenic Chinese herbs such as PR can be one of the candidates for the treatment or prevention of osteoporosis in elderly men with hypogonadism.