World Journal of Pharmaceutical and Life Sciences
WJPLS
www.wjpls.org
SJIF Impact Factor: 6.129

AN EVIDENCE-BASED JAPANESE FOOD QUALITY FROM THE STANDPOINT OF HEALTH PREFERMENT, DISEASE PROTECTION AND LONGEVITY EXTENSION: A COMPREHENSIVE REVIEW STUDY WITH A HOPE FOR A GLOBAL HEALTH ELEVATION

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Article Received on 09/04/2022 **Article Revised on 30/04/2022** **Article Accepted on 20/05/2022**

ABSTRACT

Pharmacy, medicine, and food science are all aimed not only to cure and prevent various diseases but also to enhance the health status of the human beings. Japan is rated number one in the life longevity survey and healthy life longevity survive in the world according to the latest data. The all-cause mortality rate in Japan is the lowest in the world. On the other hand, Japan won the first food culture registrations with the United Nations Educational, Scientific, and Cultural Organization on the representative list of the intangible cultural heritage in 2013. Japanese diet is characterized by high consumption of fish, mushroom, sea vegetables, soybean products, and a variety of vegetables. At the same time, Japanese diet is paid great regard to taste and visual art. It is important to represent various Japanese food items pictorially. A certain literature states that Japanese food contribute to lead their healthy life and there may be a link between Japanese diet (washoku) and longevity of the people in Japan. However, there is no reports to verify this statement from the stand point of evidence-based facet. Taking into consideration the above-mentioned attributes the current study was conducted. As conclusion, special attention should be paid to the fact that dietary effect contributes significantly outstanding outcomes of health-related statistics in the world. Many species exit within each food group in Japan, and it is beneficial to eat as many food species as possible. Unique food items distinctive to Japan play characteristic roles in health benefit and palatability. The author sincerely wish that the Japanese diet contributes to achieve the health eminence of the people in the world.

KEYWORDS: Japanese diet, life span, mortality, food ingredients, nutrient value, evidence.

INTRODUCTION AND BACKGROUND

Japan is located far east of the Eurasian continent and a geographically small country although its population is approximately 126 million, the 11th largest in the world. Japan celebrated 1n 2013 their first food culture registrations with the United Nations Educational, Scientific, and Cultural Organization on the Representative List of the Intangible Cultural Heritage of Humanity.[1]

Gabril et al. state that the Japanese traditional meals, which are characterized as high consumption of fish and soy bean products and low consumption of meat and animal fat, relies on the effective use of savory taste to enhance palatability. There may be a link between the Japanese food and longevity in Japan.[2, 3] The benefits of Japanese food that composes a diversity of plant-based ingredients and low amount of food from animal sources would not only enhance human health but also promote environmental sustainability.[4] According to the global life expectancy for men and women in OECD 2021 statistics Japan is ranked the highest (Table 1, Figure 1).

Table 1: Global life expectancy for men and women: OECD 2021 statistics.[5]

rank	Country	Life expectancy for men and women (age)			
1	Japan	84.3	11	France	82.5
2	Switzerland	83.4	12	Luxembourg	82.4
3	Korea	83.3	12	Sweden	82.4

4	Singapore	83.2	14	Iceland	82.3
4	Spain	83.2	15	Canada	82.2
6	Cyprus	83.1	16	New Zealand	82.0
7	Australia	83.0	17	Malta	81.9
7	Italy	83.0	18	Ireland	81.8
9	Israel	82.6	18	Netherlands	81.8
9	Norway	82.6	20	Germany	81.7

Global Average [2019 year]: 75.9 years old

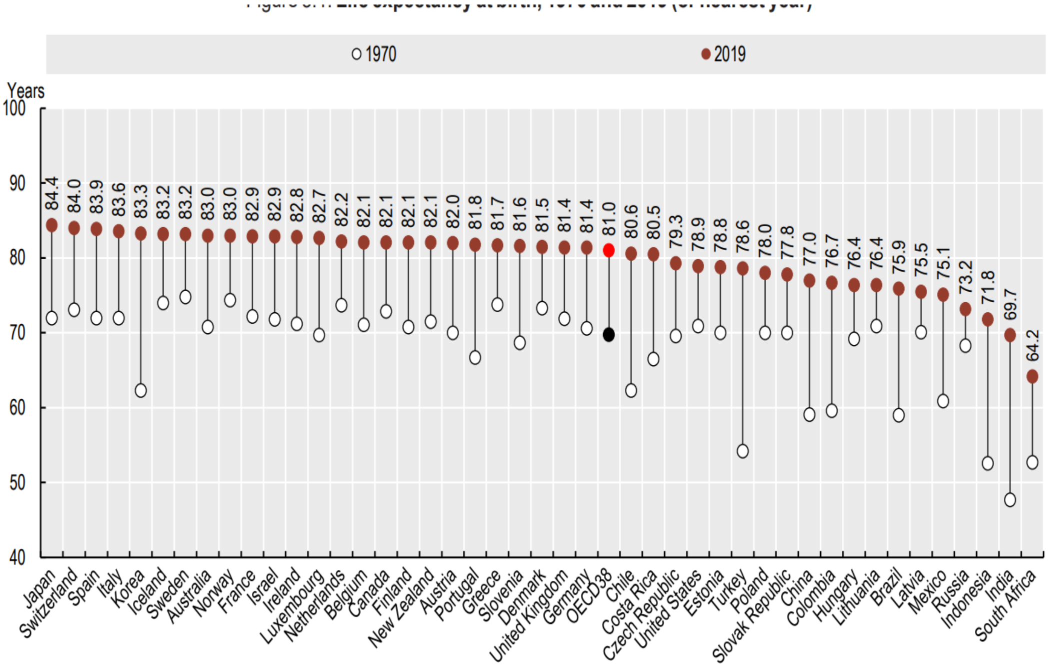


Figure 1: Life expectancy at birth among OECD countries, from 1970 to 2019 (or nearest).[6]

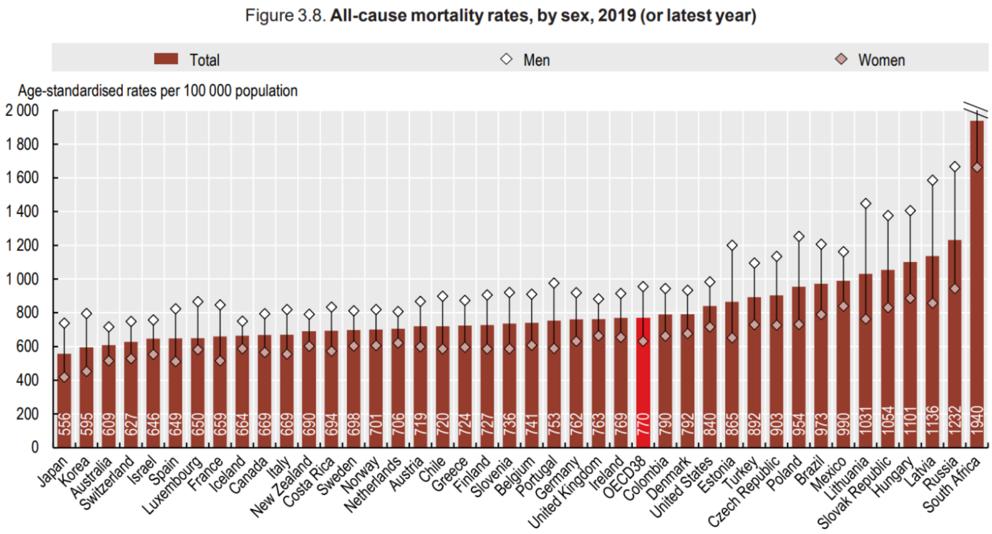
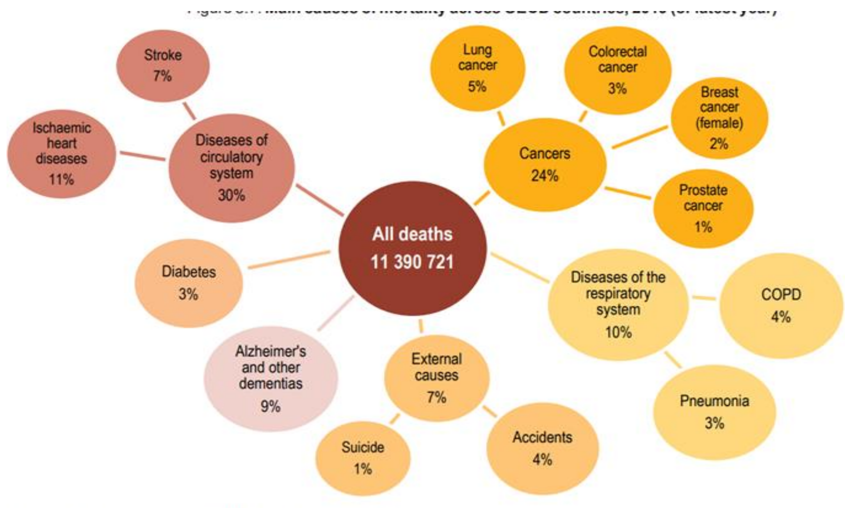


Figure 2: All-cause mortality rates, by sex among OECD counties, in 2019.



Note: Other causes of death not shown in the figure represent 17% of all deaths.

Figure 3: Main causes of mortality with their rates across OECD counties. 2019 (or nearest year).[8]

All-cause mortality rates, by sex among OECD counties, in 2019 is shown in Figure 2. Figure 3 shows main causes of mortality with their rates across OECD counties, 2019 or latest year.

Japan represents the lowest mortality rate, 556 for age standardized rates per 100,000 populations among 38 OECD countries. The closer look at the main causes elucidates those three major causes are circulatory diseases, cancer, and respiratory diseases, 30%, 24%, and 10%, respectively. As are shown in Table 4-6,8-10,12, Japanese food ingredients contain diverse vitamins and antioxidant whose play an important role to maintain healthy status and to avoid major diseases. Antioxidants prevent major chronic diseases including circulatory diseases and cancer. The advantage of fish diets to avoid atherosclerosis may be due to modulation of oxidative stress, or antioxidant activity.[9] Oxidative stress has been associated with cardiovascular disease, cancer, and other chronic diseases which are a major cause mortality. In other words, antioxidants hinder the oxidative stress and decay or prevent oxidative status.[10] On the other hand, vitamins also maintain good health and prevent major causes of mortality such as circulatory diseases and cancers.

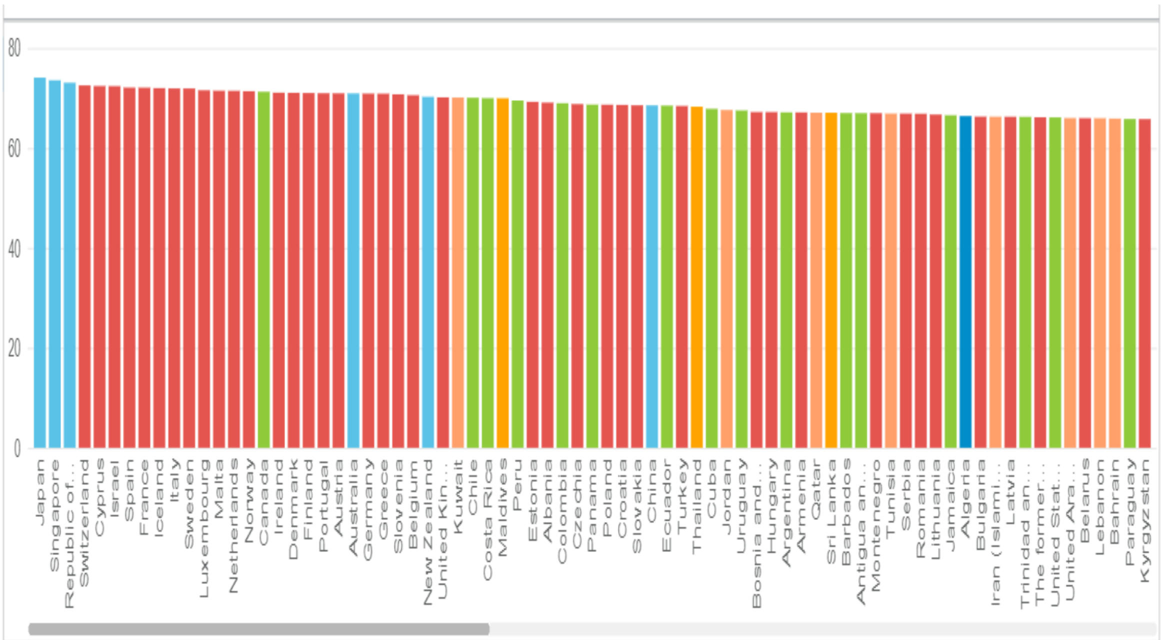


Figure 4: Healthy life expectancy at birth by country : from WHO health statistics, in latest years (retrieved February 6, 2022).[11]

Table 2: Healthy life expectancy at birth by country : from WHO health statistics, in latest years (retrieved February 6, 2022).[11]

Location	Africa	Americas	Eastern Mediterranean	Europe	South-East Asia	Western Pacific
Japan						74.09
Singapore						73.55
Republic of Korea						73.06
Switzerland				72.52		
Cyprus				72.41		
Israel				72.38		
Spain				72.09		
France				72.08		
Iceland				71.98		
Italy				71.92		
Sweden				71.91		
Luxembourg				71.55		
Malta				71.46		
Netherlands				71.44		
Norway				71.36		
Canada		71.25				
Ireland				71.07		
Denmark				71.04		
Finland				71.00		
Portugal				70.96		
Austria				70.94		
Australia						70.93
Germany				70.89		
Greece				70.87		
Slovenia				70.74		
Belgium				70.56		
New Zealand						70.24
United Kingdom of Great Britain and Northern Ireland				70.13		
Kuwait			70.09			
Chile		70.05				
Costa Rica		69.97				
Maldives					69.95	
Peru		69.50				
Estonia				69.24		
Albania				69.08		
Colombia		68.96				
Czechia				68.79		
Panama		68.68				
Poland				68.66		
Croatia				68.62		
Slovakia				68.54		

China						68.53
Ecuador		68.48				
Turkey				68.41		
Thailand					68.26	
Cuba		67.84				
Jordan			67.60			
Uruguay		67.51				
Bosnia and Herzegovina				67.19		
Hungary				67.19		
Argentina		67.13				
Armenia				67.12		
Qatar			67.06			
Sri Lanka					67.05	
Barbados		66.99				
Antigua and Barbuda		66.97				
Montenegro				66.97		
Tunisia			66.89			
Serbia				66.88		
Romania				66.85		
Lithuania				66.69		
Jamaica		66.55				
Algeria	66.39					
Bulgaria				66.28		
Iran (Islamic Republic of)			66.26			
Latvia				66.25		
Trinidad and Tobago		66.23				
The former Yugoslav Republic of Macedonia				66.14		
United States of America		66.12				
United Arab Emirates			65.99			
Belarus				65.97		
Lebanon			65.96			

Global Average [2019 year]:

Healthy life expectancy(HLE) is also called healthy-adjusted life expectancy(HALE). HLE is the average number of years that a person can expect to live in good health status; i.e. not impeded by disabling diseases or injuries. the World Health Organization (WHO) used this measurement in assessing the health and well-being of a country. According to the report of healthy life expectancy at birth by country: WHO health statistics, in latest years (retrieved February 6, 2022) Japan is ranked highest (Figure 4, Table 2).

It is now recognized that Japanese cuisine is referred to contributions to Japanese people's identity as well as the construction of local and national recognitions. It is allowed to argue that national cuisine can be considered as the intersection of a diverse academic approaches and research fields.[12]

Japan enjoys the top-ranking position for the life expectancy including both men and women in the 2021 statistics announced by UNFPA. The life expectancy is influenced by various factors such as diet, morbidity, environmental circumstances, and so on. It is believed that the diet is most importance among them.[13,14] Japanese people are gratified at their traditional cuisine *Washoku*, which has been authorized an intangible cultural property. Authentic *Washoku* is developed by Japan's mild climate with four seasons, high-quality water originated from land surrounded by mountains, and availability of a large variety of fishes and sea vegetables from the surrounding ocean.[15]

Japan has been an intangible cultural heritage certified in 2013 by the United Nations Educational, Scientific, and Cultural Organization as mentioned in the above. This Japanese traditional cuisine is called *washoku*. Japan's tourism industry thrived for the last decade, as the number of tourists increased from about 10 million in 2013 to over 30 million in 2019.[12] Together with these enthusiastic visitors excited by *Washoku* tourism, Japanese government has also been putting a lot of effort into advertising *Washoku*, emphasizing its healthiness as one of its merits.[2,4] Authentic *Washoku* requires Japan's mild climate with four seasons, quality water originated from mountainous land, and availability of a large variety of fishes and sea vegetables from the surrounding sea.[16] In this special issue of European Journal of Clinical Nutrition, we listed the health benefits of Japanese diet, first by providing an overview that explained how Japan achieved the world's highest life expectancy from dietary perspective.[17] Then, they provided four articles focusing on the health effects of fish and omega-3 polyunsaturated fatty acid,[18] sea vegetables,[19] soy,[20] and green tea,[21] plant foods, drinks and nutrients that characterize Japanese diet. Interesting findings of three prospective studies followed the reviews mentioning that intake of fermented soy foods such as natto was inversely associated with cardiovascular disease incidence but only in women. In the Japan public. Yamori et al. mentioned about soy and fish features of Japanese diet decrease the incidence of cardiovascular diseases and total cancers.[22]

Another intriguing new finding is possible enhancement of resistance against influenza by frequent green tea intake,[23] which need to be confirmed by future randomized trials. Dietary, i.e., ingredient diversity, which also characterizes Japanese diet,[24] was associated with slower hippocampal atrophy, and might give you protection against Alzheimer's disease in a 2-year follow-up study of the National Institute for Longevity Sciences-Longitudinal Study of Aging.[25] Results of one cross-sectional and one ecological study are also discussed in the present issue. The Japan Multi-Institutional Collaborative Cohort study suggested a SNP related to preference for a Japanese dietary pattern.[26] An ecological study, which utilized Food and Agriculture Organization of the United Nations Statistics Division database, explored intercountry comparisons of traditional Japanese diet score and incidence and mortality of breast cancer.[27]

Finally, from social epidemiological perspective, a benefit of school lunch program, which is also considered as an important measure to preserve *Washoku* culture for future generations,[16] was introduced to reduce socioeconomic disparities in diet quality using National Health and Nutrition Survey data.[28]

It is now recognized that Japanese cuisine is referred to contributions to Japanese people's identity as well as the construction of local and national recognitions. It is confirmed to argue that national cuisine can be considered as the intersection of a diverse academic approaches and research fields.[12] Again, Gabril et al. state that the Japanese traditional meals, which are characterized by high consumption of fish and soy bean products and low consumption of meat and animal fat relies on the effective use of savory taste to enhance palatability. There may be a link between the Japanese food and longevity in Japan.[2] Again the benefits of Japanese food that composes a diversity of plant-based ingredients and low amount of food from animal sources would not only enhance human health but also promote environmental sustainability.[4]

1. STATISTICS AND EVIDENCE

Details and practical applications of Healthy Eating Index (HEI) are reported in the literatures from different angles. HEI is a measure for accessing diet quality, specifically the degree to which a set of foods aligns with the Dietary Guidelines for Americans (DGA).[29,30] The HEI has been density based after the 2015 version rather than absolute amounts and common set of standards that are applicable across individuals and settings.[30,31] There have been over 300 publications using the HEI to evaluate both prospective and cross-sectional associations between diet quality and health outcomes, for example, risk for cardiovascular disease mortality.[32] It has also been used to describe diet quality in the US population.[33], including population subgroups such as Mexican Americans,[34] children,[35,36] and cancer survivors.[37,38] In addition, the HEI has been used to evaluate diet quality of different levels of food environment, such as the US food supply restaurant.[39]

Murakami et al. as a cross-sectional study assessed the overall diet quality of Japanese using the Healthy Eating Index-2015 (HEI-2015) and Nutrition Rich Food Index 9.3 (NRF9.3), and compared diet quality scores between Japanese and American.[40] They reported that the mean total scores of HEI-2015 and NRF-9.3 were similar between Japanese adults (51.9 and 448, respectively) and US adults (52.8 and 435, respectively). Morze et al. studied diet quality by assessing the following three indexes and score, Healthy Eating Index, Alternative Healthy Eating Index, Dietary Approaches to Stop Hypertension. They concluded that high quality assessed by the three indexes and score is inversely associated with risk of all -cause mortality, cardiovascular disease, and cancer mortality among cancer survivors.

2. INDICATORS FOR DIET QUALITY

Japanese Food Guide Spinning Top "eating pyramid method" was developed by Japanese Ministry of Health, Labor, and Welfare, and the Ministry of Agriculture, Forestry and Fisheries as shown in Figure 5. This was developed in 2005 on the food-based Dietary Guidelines in Japanese and its aim is to provide recommendations of food selection and quantities for a healthy diet that can be easily adopted by the Japanese public taking account of typical Japanese diet characterized by high intakes of rice, soybean products, fish, sea vegetables, and green tea, and low intakes of animal fat and soft drinks, consisting of lower energy density as a whole Japanese.[39]

Again, Food Guide Spinning Top is created on the food-based Dietary Guidelines in Japanese and its aim is to provide recommendations of food selection and quantities for a healthy diet. The counterpart system in the United State is HEI which measures diet quality that can be used as an alignment of diet patterns with the Dietary Guideline for Americans (DGA). As we observed, Japan and USA set up the similar system with an aim to increase the health status of the own country. But quite difference in healthy life expectancy: Japan is 74.09 years old (1st out of WHO counties) and the United States is 66.12 years old (68th out of 172 WHO countries). It is hypothesized that Japanese unique diet patterns such diverse fish products, variety of vegetables, see vegetable products, mushroom products and soybean products, and original unique products including natto, ume, green tea and aloe with low intakes of fat products contribute to the highest healthy life expectancy and the lowest mortality.[40]

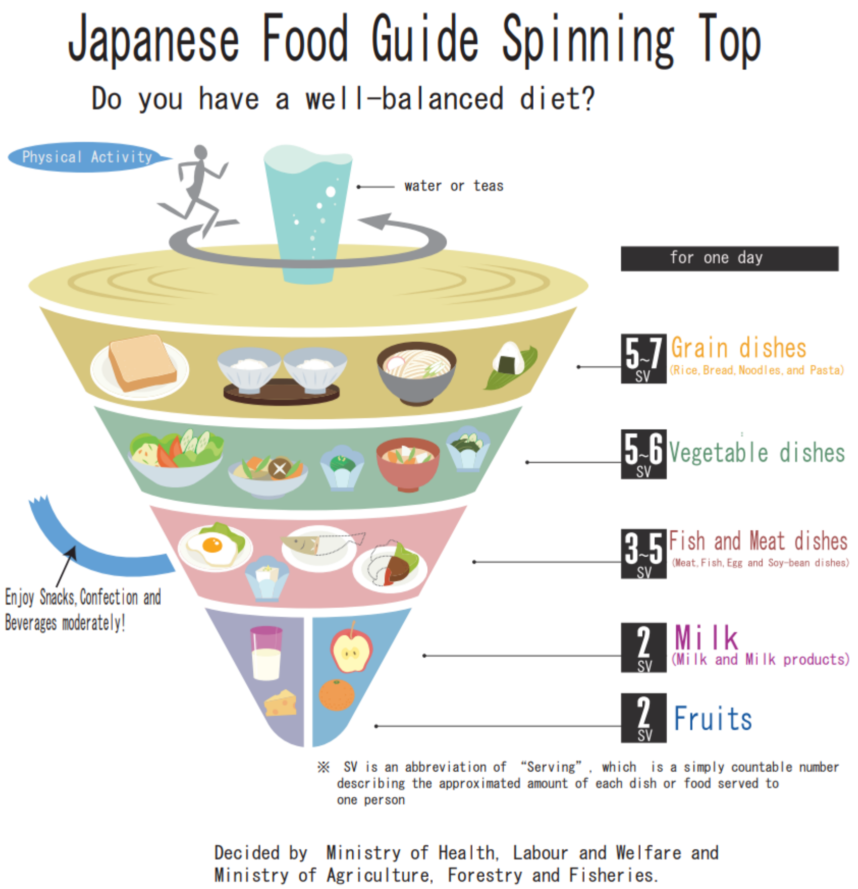


Figure 5: Graphical presentation of the Japanese Food Guideline Spinning Top.[41]

Higher diet quality scores have been consistently associated with a lower risk of mortality.[42-49] Oba et al. studied an association between the diet based on the Japanese Food Guideline Spinning Top and mortality among men and women in a general Japanese population. They elucidated that the adherence score was significantly associated with a lower risk of mortality of all causes among women.[50] Nishimura et al. studied adherence to the Japanese Food Guide Spinning Top in relation to the metabolic risk factors to young Japanese women.[51]

Healthy Eating Index (HEI) was developed to measure diet quality that can be used as an alignment of diet patterns with the Dietary Guideline for Americans (DGA).[35] Pantizza tested the predictive validity of the

HEI-2015 in the multiethnic Cohort. Their results demonstrated that following a diet aligned with DGAs 2015-2020 recommendations is associated lower risk of mortality of all-cause, cardiovascular disease (CVD) and cancer.[38] Settler et. al. reported the association of 2010 HEI with characteristics of youth food preparation in low-income African American homes.[36] They mentioned that low-income African American youths are involved in food preparation by contributing to their food consumption and diet quality. Furthermore, they stated that if a food preparation education approach is taken, adding foods such as fruit and vegetables, into their preparation habit of youth could be better for their diet quality. Since Japanese diets are rich in fruit and vegetables, the authors indirectly recommend the Japanese style diet. As far as food intake patterns and their association with the disease risk factor is concerned, Htun et al. reported that the traditional Japanese diet showed a protective effect against hypertension in men, while meat-fat pattern is related to all cardiovascular risk factors in men.[37]

Minami et. al. investigated by using Cox proportional hazard model an association between pretreatment of six kinds of Japanese foods intake including soy foods, miso (soy bean paste) soup, and sea vegetable foods with survival rate of digestive tract cancers (stomach, 1931; colon, 793; rectum, 510) diagnosed during 1997-2013 at an institution in Japan. Pretreatment dietary intake was assessed using a food frequency questionnaire and the Cox proportional model was used to estimate hazard ration (HR), and 95% confidence interval (CI). Among the patients with stomach cancer frequency intake of soy foods was inversely associated with the risk of all cause (Ptrend four frequency groups = 0.01; HR = 0.722, 95% CI: 0.50-1.04 for highest vs. lowest group) and stomach cancer (Ptrend = 0.03; HR = 0.63, 95% CI: 0.40-0.99). A similar inverse association was found for intake of miso group. Rectal cancer patient who had frequently consumed sea vegetable tented to have a lower risk of rectal cancer death (Ptrend = 0.02). They indicated that pretreatment intake of Japanese foods such as say foods and sea vegetable foods may have favorable effects on survival of stomach and colorectal cancers.[28]

As late as in 1960's, the life expectancy in Japan was the shortest among G7 countries due to high mortality rates from cerebrovascular disease particularly. In a recent international comparison statistics among G7 countries, Japan had the longest life expectancy mainly due to low mortality rates of ischemic heart disease and cancer, particularly breast and prostate cancer.[52]

3. Analytical Characteristic of unique foods and their ingredients in Japan

Ito et al. studied micronutrient intake adequacy in men and women with a healthy Japanese dietary pattern based on the Dietary Reference Intakes for Japanese 2015 (DRIs-J 2015) in men and women.[53] Micronutrients include vitamins and minerals. Although micronutrients are small amounts as food ingredient, they are necessary to maintain health status. Vitamins include fat soluble vitamins such as vitamin A,D,E, K, and war soluble vitamins such as vitamin B1, B2, B6, B12, folic acid, niacin, biotin, pantothenic acid, and vitamin C. It is necessary to consume a variety of food items, not limiting the type of food. Vitamins are indispensable nutrients to maintain proper metabolic cycles and to perform to maintain different bodily functions to keep the body healthy including immune-boosting function.[54] In other words, most of Japanese are lean and balanced, eating a variety of foods such as omega-rich fish, rice, whole grains, tofu, soy, miso (soy bean paste), sea vegetables, mushrooms, fruits and vegetables. All these foods are low in saturated fats and sugars. They are rich in vitamins and minerals that reduce the risk of cancers and heart disease. Therefore, the sufficient intake of Japanese diet has helped to enhance the life expectancy and to decrease the mortality among Japanese population.[55,56]

Micronutrient intakes were quantified using the dietary reference intakes score (DRIs-score) for 21 (based on DRIs-J 2015). They found that a healthy Japanese dietary pattern is associated with adequate micronutrient intakes.[56] Japanese foods are rich in micronutrients, as shown in the following Tables 4-6 8-10,12. This evidence elucidated that Japan represents the lowest mortality and the longest life span and the longest healthy life expectancy.

3.1 MUSHROOMS

Medicinally mushrooms are widely used in East Asia including Japan for the treatment of various diseases-, especially for contemporary cancer. Western countries have been paying growing attention to medicinal mushrooms and an increasing number of pre-clinical studies indicate distinct anti-cancer and regenerative properties. With this aspect kept in mind, Jeitler et al. reviewed clinical trials of mushrooms whose studies were randomly conducted with placebo orally administered and found that eight studies met their criteria. The mushrooms in question include Agericus silvaricus, Agaricus blazai, murill. Antrodia cinnamomea, Conolus versicolor, and Ganoderma lucidum.[17]

In Japan the number of mushrooms amount to be 5,000 to 6,000 including the ones without names. There are various kinds of edible mushrooms in Japan as shown in Figure 6. Types of mushrooms which the Japanese eat include shiitake mushroom elingi mushroom, hen of the woods, brown beech mushroom, bunashimeji, shimeji, truffle, nameko, and oyster fungus.

Table 3: Medicinal benefits of various mushrooms.

English name ・ Scientific name	[reference] medicinal benefits
cloud ear mushroom ・ Auricularia polytricha	[56] effect on dyslipidemia [69] decreases the serum total cholesterol and LDL, and increases serum HDL
shiitake mushroom ・ Lentinus edodes	[58] antifungal activity [59] cytostatic and immunomodulatory properties
king trumpet ・ Pleurotus eryngii	[60] estrogen receptor regulation
hen of the woods ・ Tricholoma matsutake	[61] antioxidant and antitumor activities
beechage ・ Hypsizygus marmoreus	[62] antihypertensive activity [64] growth inhibitory effect against human leukemic cells [65] antifungal activity [66] increases antioxidant activity through hydrogen rich water
symeji ・ Lyophyllum shimeji	[67] antifungal activity
truffle ・ T. magnatum Pico	[68] antioxidant and anti-inflammatory activities
nameko ・ Pholiota nameko, Collybia nameko	[70] antioxidant activity
oyster mushroom ・ Pleurotus ostreatus	[71] effect on malnutrition diseases
maitake, ・ Grifola frondosa	[72] improves glucose tolerance [73] bioactive ingredients valuable for nutraceutical and pharmaceutical applications+
velvet shank	[74] source of nutrients and potential in pharmaceutical drug development.

Table 4: Food component values of minerals per 100g edible part of mushroom.[76]

name	sodium (mg)	potassium(mg)	calcium(mg)	magnesium(mg)	phosphate(mg)	i-+ron (mg)	zinc(mg)	copper(mg)	mangan(mg)	iodine(μg)	selenium(μg)	chromium(μg)	molybdenum(μg)
cloud ear, dry, kikurage	59	1000	310	210	230	35.0	3.1	0.31	6.18	7	9	27	6
Lentinus edodes, shiitake, raw	1	270	2	16	61	0.4	0.7	0.06	0.270	0	1	Tr	1
king trumpet, eringi, raw	2	340	Tr	12	89	0.3	0.6	0.10	0.06	1	2	0	2
hen of the woods, atsutake, raw	2	410	6	8	40	1.3	0.8	0.24	0.12	3	82	14	1
Symeji lyophylum, honshineji, raw	1	310	2	8	76	0.6	0.7	0.32	0.18	-	-	-	^
collybia, nameko, raw	3	240	4	10	68	0.7	0.5	0.11	0.06	Tr	2	Tr	1
oyster mushroom hiratake, raw	2	340	1	15	100	0.7	1.0	0.15	0.16	0	6	1	1
Grifola frondose, maitake, raw	0	230	Tr	10	54	0.2	0.7	0.22	0.04	0	2	1	1
v-elvet shank, enokidake, raw	2	340	Tr	15	110	1.1	0.6	0.10	0.07	0	1	0	Tr

Table 5: Food component values of vitamins per 100g edible part of mushroom based on Japan Food Standard Ingredient Table.

name	Retinol (μg)	β-Carotin(μg)	Act. Retinol(μ g)	Vitamin D(μ g)	Vitamin E (mg)	Vitamin K(μ g)	Vitamin B1(mg)	Vitamin B2(mg)	Niacin(mg)	Vitamin B6(mg)	Vitamin B12(μ g)	Folic acid (μ g)	Pantothenic acid (mg)	Biotin(μg)	Vitamin C(mg)
cloud ear, kikurage, dry	(0)	(0)	(0)	85.0	0	0	0.19	0.87	5.5	0.10	(0)	87	1.14	27.0	0
Lentinus, enode shiitake, raw	(0)	(0)	(0)	0.4	(0)	(0)	0.13	0.22	4.0	0.19	(0)	75	0.95	7.7	0
king trumpet, eringi, raw	(0)	(0)	(0)	1.2	0	(0)	0.11	0.22	6.7	0.14	(0)	65	1.16	6.9	0
hen of woods, matsutake, raw	0	(0)	(0)	0.6	(0)	0	0.10	0.10	8.3	0.15	(0)	63	1.91	18.0	0
Symedi lyophylum, honshineji, raw	(0)	(0)	(0)	0.6	(0)	(0)	0.07	0.28	5.5	0.19	(0)	24	1.59	-	0
collybia, nameko, raw	(0)	(0)	(0)	0	0	(0)	0.07	0.12	5.5	0.05	Tr	60	1.29	7.4	0
oyster mushroom, hiratake, raw	0	(9)	(0)	0.3	(0)	0	0.40	0.40	11.0	0.10	(0)	92	2.40	12.0	0
Grifola frondose, maitake, raw	(0)	(0)	(0)	4.9	(0)	(0)	0.09	0.19	5.4	0.06	(0)	53	0.56	24.0	0
velvet shank, enokidake, raw	(0)	(0)	(0)	0.9	0	0	0.24	0.17	7.4	0.12	(0)	75	1.40	11.0	0

Table 6: Food component values of essential food ingredients per 100g edible part of mushroom based on Japan Food Standard Ingredient Table.

name	Energy (Kcal)	Protein (g)	Triacylglycerol (g)	Saturated (g)	n-3 Unsaturated (g)	n-6 Unsaturated (g)	Cholesterol (mg)	Plant fiber (g)	Organic acids (g)	Carbohydrate (g)	Ash content （g）
cloud ear, kikurage, dry	216	5.3	1.3	0.29	0.01	0.60	0	57.4	0	19.7	4.0
Lentinus, enode shiitake, raw	34	1.9	0.2	0.04	0	0.16	(0)	5.5	0.2	3.9	0.7
king trumpet, eringi, raw	31	1.7	0.2	0.04	0	0.12	(0)	3.4	-	6.5	0.7
hen of woods, matsutake, raw	32	1.2	0.2	0.06	0	0.06	(0)	4.7	-	4.9	0.9
Symedi lyophylum honshineji, raw	21	2.5	0.4	-	-	-	(0)	1.9	-	0.9	0.6
collybia, nameko, raw	21	1.0	0.1	0.02	0	0.07	1	3.4	-	4.4	0.5
oyster mushroom, hiratake, raw	34	2.1	0.1	0.02	0	0.08	(0)	2.6	-	6.1	0.8
Grifola frondose, maitake, raw	22	1.2	0.3	0.06	Tr	0.14	(0)	3.5	-	1.9	0.6
velvet shank, enokidake, raw	34	1.6	0.1	0.02	0.02	0.05	0	3.9	-	5.5	0.9

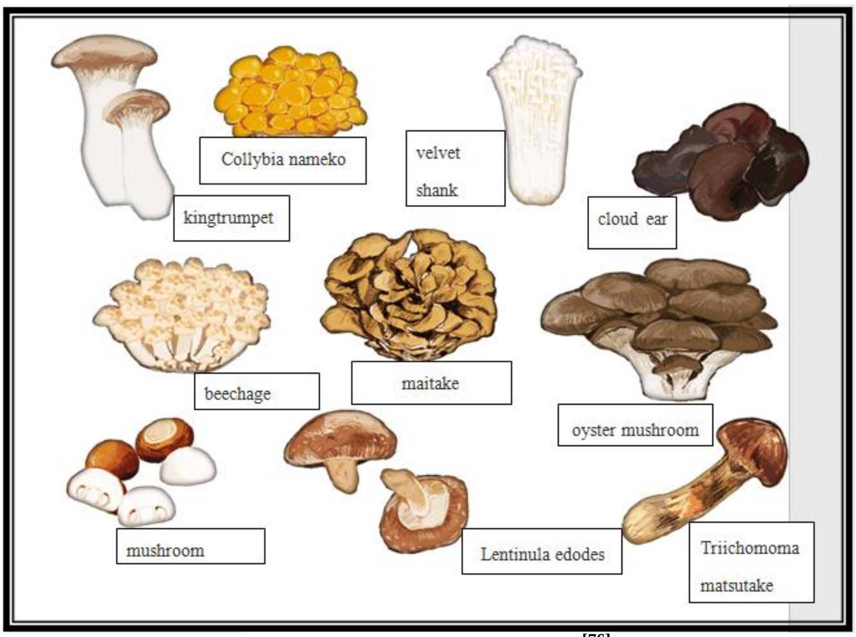


Figure 6: a list of mushrooms.[76]

Each mushroom contains a unique nutrient, it is important to eat a variety of mushrooms in daily dishes. Since Japanese groceries display various kinds of mushrooms as shown in Figure 6, Japanese citizens can intake a variety of nutrients from mushrooms.

Israilidesa D, et al. reported that Lentinula has cytostatic and immunomodulatory properties.[59] Hori et al. reported that maitake (Grifola frondosa) improves glucose tolerance of experimental diabetic rats.[72] Wu J et al. mentioned that Grifola frondosa (maitake) contains bioactive ingredients and can exhibit nutraceutical and pharmaceutical applications.[73] Kikuchi T et al. reported that ergostane-type sterols from king trumpet mushroom (Pleurotus eryngii) exhibits inhibitory effects on aromatase, which is rate-limiting estrogen biosynthesis enzyme, and the target genes of an estrogen receptor is responsible for breast cancer.[60] Bound estrogen receptor to estrogen triggers transcription of target genes and aromatase converts androgens into estrogens.[77] Bae K, et al. reported that acupuncture for aromatase inhibitor–induced arthralgia.[78] Kazue et al. reported antibacterial activity of Lentinula endodes grown in liquid medium.[57]

Wasser SP reported that from the fruiting bodies of the shiitake mushroom, a novel protein lectin with antifungal activity was isolated.[58] Budinastiti W et al. reported the effect of cloud ear fungus (Auricularia polytricha) on serum total cholesterol, LDL and HDL levels on Wistar rats induced by reused cooking oil.[69]

Zheng et al. reported antioxidant activity of sulfuric acid-treated degraded polysaccharides from Pholiota nameko. They obtained three stepwise degraded polysaccharides(AIPS-1, AIPA-2, and AIPS-3) by increasing the strength of sulfuric acid and the triple helical did not change significantly, while the molar ratio of monosaccharide changed. They establish an oxidative zebrafish model which demonstrated that the ability of AIPS-3 and AIPS-4 to scavenge free radicals in zebrafish was significantly improved compared to AIPS-1. They concluded that sulfuric acid treatment is an effective method for improving an antioxidant activity of polysaccharide.[70]

You et al. purified polysaccharides from Tricholoma matsutake and obtained three fractions of polysaccharides (TM-P1, TM-P2, and TM-P3). TM-P2 showed the strongest in-vitro antioxidant and antitumor activities. The oxygen radical absorbance capacity of TM-P2 was 2100.44 μmol Trolox/g and anti-proliferative activities of TM-P2 on the growth of HepG2 and A549 cell were 67.98% and 59.04% respectively.[61] Kang et al. studied an antihypertensive angiotensin 1-converting enzyme inhibitory peptide from Hypsizygus marmoreus. The antihypertensive angiotensin I-converting enzyme (ACE) inhibitor in water extracts from Hypsizygus marmoreus was purified with ultrafiltration, and the purified ACE inhibitor with inhibitory activity of IC_{50} value of 0.19 mg/mL was obtained. They found that the purified ACE inhibitor was a new oligopeptide with the sequence of LSMGSASLSP. Its molecular weight was estimated to be 567.3 Da and the water extracts containing ACE inhibitor from Hypsizygus marmoreus showed a clear antihypertensive action spontaneously against hypertensive rat.[62]

Liu reported the antioxidant, anti-inflammatory activities of mycelia selenium from Hypsizygus marmoreus (bunashimeji). They conducted animal investigations using sixty Kunming stain mice and elucidated that Mycelia selenium polysaccharides (MSPS) from Hypsizigus marmoreus SK-03 markedly ameliorated pulmonary injuries by the regulations of related inflammatory events via the observably antioxidant effects at the dose of 800 mg/kg.[63] Tsai et al. reported that a novel glycoprotein from mushroom Hypsizygus marmoreus exhibits growth inhibitory effect against human leukemic U937 cells. They extracted crude protein from basidoma followed by Sephacryl gel filtration, and a protein which exerted high growth inhibitory effect against human leukemic cell was isolated and named HM-3A. They advocated that HM-3A is worth further investigating for anticancer use.[64]

An antifungal protein (HM-af) was purified from the culinary-medicinal Hypsizygus marmoreus (Park, bunashimeji), and HM-af exhibited antifungal activity against Flammulina velutipes.[65] Lamk et al. isolated a novel ribosome inactivating protein with a molecular weight of 20 kDa exhibiting antifungal activity against Physalospora piricola (IC_{50} = 2.5 μM).[66] Chen et al. reported that hydrogen rich water increases the quality of Hypsizygus marmoreus enhancing antioxidant activity.[67]

Beara et al. investigated phenolic profile, antioxidant, anti-inflammatory and cytotoxic activity of the still insufficiently explored black summer truffles (Tuber aestivum vittad.) and white truffles (Tuber magnatum Pico) which showed anti-inflammatory potential by inhibiting COX-1 and 12-LOX pathway product synthesis. Methanol extracts exserted cytotoxicity against some tumor cell lines (HeLa, MCF7, HT-29), besides the prominent activity of water extracts towards breast adenocarcinoma (MCF-7).[68]

Gao et al. investigated the antioxidant and multiple organ protective effects of mycelia polysaccharides from Pleurotus eryngii from high fat emulsion (HFE)- induced hypertriglyceridemia mice. Upon the completion of the experiment, they found that acid-extracted mycelia polysaccharides (Ac-MPS) have potential ability to relieve the hypertriglyceridemia and to prevent oxidative stress by decreasing levels of TG, TCLDL-C. Ac-MPS also elevated contents of HlDL-C in serum, increasing the activities of SOD, GSH-Px CAT, and T-AOC. And it downregulated MDA and MDO contents in liver, heart, kidney, and spleen. They concluded that Ac-MPS have the potential to develop new drugs for hypertriglyceridemia-induced organ failure.[79]

Natural products related to Coriolus (C) versicolor and Ganoderma (G) lucidum are often applied as a complementary therapeutic option for different stages and types of cancers. Zhong et al. evaluated efficacy and safety of those products for cancer therapy.[80] Twenty-three trials involving 4246 patients were included in their studies. C. versicolor and G. lucidum related natural products were significantly associated with lower risks of mortality (HR: 0.82; 95% Cl: 0.72, 0.94) and higher total efficacy (RR; 1.30; 95% Cl: 1.09, 1.55), but not associated with control rate (RR: 1.05; 95% Cl:0.96). They concluded that C. versicolor and G. lucidum related natural products might have potential benefits on the overall survival and quality of life in cancer patients.

Li J et al. pursued a meta-analysis of observational studies based on the perspective that dietary mushroom intake may reduce the risk of breast cancer evidence. They conducted relevant studies by a search of PubMed, Web of Science, Google Scholar and found that greater edible mushroom consumption may be associated with a lower risk of breast cancer.[81] Phellinus linteus (Japanese name is "meshimakobu", and English name is "black hoof mushroom") is a mushroom which is shaped like a hoof, has a bitter taste, and grows on mulberry trees. Poreini is a type of mushroom with a unique and elegant aroma. Poreini does not represent single species but a group of several species which include Boletus (B) aerreus, B. aestivaris, B. adevis and B. phenophyrus.[29] It has been suggested in the previous studies that porecini mushrooms improve blood flow and relieve tension in muscles and joints.[82]

Lee et al. studied potential impact of Phellinus (P) linteus on adherence to adjuvant treatment after curative resection of pancreatic ductal adenocarcinoma. Two hundred and sixty-one patients who underwent pancreatectomy were enrolled in their study. Among them, 161 patient received adjuvant treatment after curative resection. Cox's proportional hazard models revealed that perioperative transfusion, and completion of adjuvant treatment were significantly correlated with cancer recurrence and cancer-related death (P< .05). The structure is similar to that of Agaricus bisporus lectin. Using the appropriate co-crystals, the interactions of BEL with specific mono- and disaccharides were also studied by X-ray diffraction. The six structures of carbohydrate complexes interact with the lectin and shed light on the selectivity of the two distinct binding sites present in each protomer.[83] Methanol extract of B. edulis (approximately 2 mg/mL) showed a high 2,2-diphenyl-pierylhydrazy scavenging activity close to 90%.[84] Guo et al. explored the potential effect of macro-fungi as a natural source of bioactive compounds by evaluating the antioxidant properties and polysaccharide contents of 49 edible macro-fungi. Their elucidated positive correlations between antioxidant capacity and total phenolic content indicating that phenolic compounds could be the main contributors of antioxidant capacities of these macro-fungi. In addition, they identified and quantified many bioactive compounds such as gallic, homogentisic, protocatechuic, and p-hydroxybenzoic acids.[85]

Luo et al. extracted a water-soluble polysaccharide (BEBP) from B. edutis and obtained three major polysaccharides BEBP-1, BEBP-2, and BEBP-3. The evaluation of antioxidant activities both in vitro, and in vivo suggested that BEBP-3 had good potential antioxidant activity.[86] Deepalakshmi et al. stated in their review that Pleurotus ostreatus, a novel edible mushroom, with high nutritional and biomedical importance are effective on a large number of malnutrition diseases.[87]

Horio et al. postulated that the bioactive substances present in maitake can ameliorate the symptoms of diabetes.[88] They investigated the effects of maitake on insulin concentration, organ weight, serum composition, and islets of Langerhans in streptozotocin-induced diabetic rats and postulated that the bioactive substances present in Maitake can ameliorate the symptoms of diabetes. They mentioned in their review article that many bioactive constituents isolated from Ammulina velutipes (enoki, velvet shank, and golden needle mushroom or winter mushroom) containing carbohydrates, protein, lipids, glycoproteins, phenols, and sesquiterpenes have been demonstrated to exhibit various biological activities such as antitumor, anti-atherosclerotic, thrombosis inhibition, antihypertensive, cholesterol lowering effects, anti-aging, antioxidant properties, ability to aid with restoring memory and overcoming learning deficits, anti-inflammatory, immunomodulatory, anti-bacterial, ribosome inactivation and melanosis inhibition.[89]

3.2 SEA VEGETABLES

See vegetables (this, the author believe, is more proper naming than seaweeds), in general, is considered to contain ingredients against lifestyle-related diseases. Therefore, consumption of sea vegetables might contribute to the Japanese longest longevity by preventing lifestyle-related diseases. Murai et al. Conducted a study among middle-aged Japanese men and women and reported that seaweed intake was inversely associated with incidence of ischemic heart disease and mortality from stroke probably due to blood pressure and lipid lowering effects.[90]

Rectal cancer patients who frequently consumed sea vegetables tended to have a lower risk of rectal cancer death (Ptend = 0.02). Newly diagnosed 1683 malignant gastric tumor patients were recruited between January 1997 and December 2013 in a Japanese hospital. The study was pursued by food frequency questionnaire (FFQ) method and selected 40 food items. Among them, 6 food items are considered to be traditional Japanese food items which include fresh fish, dried fish, sea vegetable, Japanese pickle, soy food, and bean paste soup.[28] Table 6 shows a list of sea-vegetables and their medical activity, and Figure 7 shows a pictorial list of edible sea vegetables.

Table 6: A list of sea-vegetables and their medical activity.

name	Medical activity [reference]
Undaria pinnatifida fucoidan	[91] recover immunity of immunosuppressed mice
Undaria pinnatifida	[92] antioxidant activity depending on different molecular weight fractions
hizikia, Sargassum fusiforme	[93] improves memory and reduces amyloid plaque load in an Alzheimer's disease mouse model
root of the wakame seaweed, Sporophyll of Undaria pinnatifida (Mekabu)	[94] antiviral activity
Sargassum fusiforme (Kjellman), Setchell	[32] antibacterial effect
Fucoidan standard from Sigma	[96] antioxidant ability
genus Gloiopeltis	[97] immune-enhancing effects
Cladosiphon okamuranus	[98] antiviral activity
agar weed (kanten)	[99] plant fiber to protect metabolic syndrome
sea lettuce	[100] antioxidant activity
sea grape	[101] improve cardiovascular and metabolic syndromes

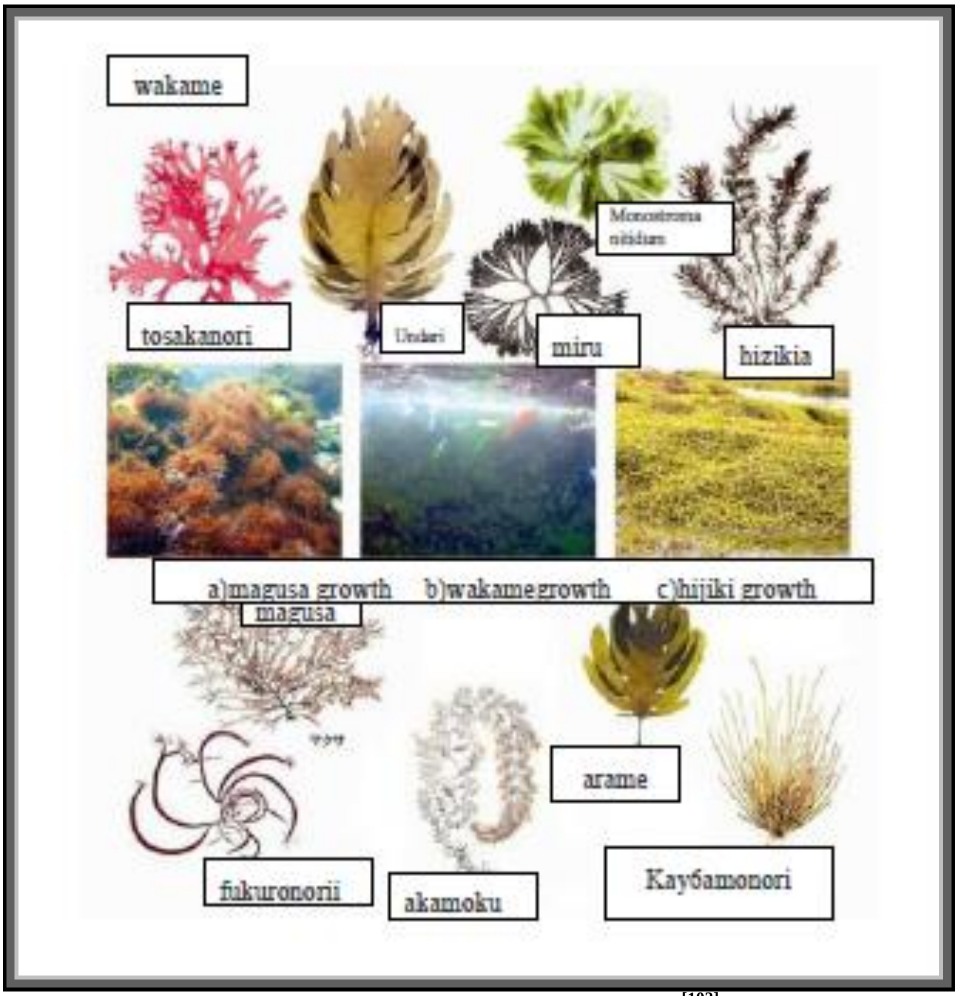


Figure 7: A list of edible sea vegitables.[102]

Note: This list was cited from Sea Vegetable Laboratory of Mie University, Mie-Prefecture, Japan

Table 8: Food component values of minerals per 100g edible part of sea vegetables based on Japan Food Standard Ingredient Table.[103]

name	sodium (mg)	potassium(mg)	calcium(mg)	magnesium(mg)	phosphate(mg)	iron (mg)	zinc(mg)	copper(mg)	mangan(mg)	iodine(µg)	selenium(µg)	chromium(µg)	molybdenum(µg)
wakame, Undaria penatifida	610	730	100	110	36	0.7	0.3	0.02	0.05	1600	1	1	3
root of the wakame	170	88	77	61	26	0.3	02	0.02	0.03	390	Tr	1	2
hizikia	1800	6400	1000	840	93	58	1.0	0.48	0.82	45000	7	26	17
kelp (sea cabbage)	3000	5200	430	700	320	3.0	0.9	0.19	0.41	210000	2	5	15
genus Gloiopeltis (funori)	2700	600	330	730	130	4.8	1.8	0.38	0.65	-	-	-	-
mozuku, Cladosipon okamuranus	90	2	22	12	2	0.7	0.3	0.01	0.03	-	-	-	-
agar weed (kanten)	1900	3100	230	1100	180	6.0	3.0	0.24	0.63	-	-	-	-
sea lettuce (aosa)	3900	3200	490	3200	160	5.3	1.2	0.80	17.00	2200	8	160	23
sea grapes	330	39	34	51	10	0.8	Tr	0.01	0.08	80	0	Tr	Tr

Table 9: Food component values of vitamins per 100g edible part of sea vegetables based on Japan Food Standard Ingredient Table.[103]

Name	Retinol (µg)	β-Carotin(µg)	Act. Retinol(µg)	Vitamin D(µg)	Vitamin E (mg)	Vitamin K(µg)	Vitamin B1(mg)	Vitamin B2(mg) (B2(mg)vi	Niacin(mg)	Vitamin B6(mg)	Vitamin B12(µg)	Folic acid (µg)	Pantothenic acid (mg)	Biotin(µg)	Vitamin C(mg)
wakame, Undaria penatifida	(0)	940	79	(0)	0.1	140	0.07	0.18	(1.5)	0.03	0.3	29	0.19	4.2	15
root of the wakame	(0)	240	20	(0)	0.1	40	0.02	0.03	0.4	0.01	0	36	0.05	2.2	2
hizikia	(0)	4400	360	(0)	5.0	580	0.09	0.42	3.4	0	0	93	0.30	17.0	0
kelp (sea cabbage)	(0)	780	65	(0)	0.3	240	0.19	0.41	(3.7)	0.02	0.1	38	0.02	16.0	20
genus Gloiopeltis (funori)	(0)	700	59	(0)	0.7	430	0.16	0.61	(4.6)	0.13	0	68	0.94	-	1
mozuku, Cladosipon okamuranus	(0)	180	15	(0)	0.1	14	Tr	0.01	0.1	Tr	0.1	2	0	-	0
agar weed (kanten)	(0)	200	17	(0)	0.2	730	0.08	0.83	4.9	0.08	0.5	93	0.29	-	Tr
sea lettuce (aosa)	(0)	2700	220	(0)	1.1	5	0.07	0.48	16.0	0.09	1.3	180	0.44	31.0	25
sea grapes	(0)	120	10	(0)	0.2	35	Tr	0.01	(0.1)	0	0	4	0	0.1	Tr

Table 10: Food component values of essential food ingredients per 100g edible part of sea-vegetables.

Name	Energy (Kcal)	Protein (g)	Triacylglycerol (g)	Saturated (g)	n-3 unsaturated(g)	n-6 unsaturated (g)	Cholesterol (mg)	Plant fiber (g)	Organic acids (g)	Carbohydrate (g)	Ash content (g)
wakame, Undaria penatifida	2.4	(1.4)	(0.1)	(0.1)	(0.04)	(0.02)	0	3.6	-	2.6	3.3
root of the wakame	14	0.7	0.5	0.22	0.03	0.08	0	3.4	-	0	0.9
hizikia	186	9.2	3.2	-	-	-	Tr	51.8	-	4.2	25.2
kelp (sea cabbage)	205	(6.7)	(1.1)	(0.40)	(0.13)	(0.23)	0	36.8	-	23.7	21.7
genus Gloiopeltis (funori)	207	(10.7)	(0.6)	(0.15)	(0.32)	(0.06)	24	43.1	-	18.2	12.7
mozuku, Cladosipon, okamuranus	4	0.2	(0.1)	(0.03)	(0.01)	(0.01)	0	1.4	-	0.1	0.6
agar weed (kanten)	194	16.1	1.0	-	-	-	51	47.3	-	6.5	13.9
sea lettuce (aosa)	201	16.9	0.4	0.12	0.10	0.03	1	29.1	-	18.0	18.7
sea grapes	6	0.5	Tr	0.02	0.01	0.01	0	0.8	-	0.5	1.2

Fucoidan extracted from Sporophyll exhibits antioxidant activity depending on different molecular weight fractions. Yu et al. obtained fucoidan fractions with molecular weight cutoffs (MWCO) of >300 kDa and <10 kDa by via dialysis. They compared the fucoidan standard from Sigma (Fstd, ≥95, CAS: 9072-19-mpto9), fucoidan crude extract (WH), >300 kDa fraction (300k) and <10 kDa fraction (10k) in terms of antioxidant capacity. They found that the primary antioxidant ability of the 10k is significantly higher than that of the 300k, WH, and Fstd, but the secondary antioxidant capabilities of the 10k and 300k were similar, and both were higher than that of the butylated hydroxyanisole (BHA).[92] Hewage et al. studied the effect of fucoidans isolated from sporophylls of Undaria pinnatifida on asthma symptoms such as the inflammatory response and mucus secretion using a mouse model.[104]

Bogie et al, reported that Sargassum fusiforme improves memory and reduces amyloid plaque load in an Alzheimer's disease (AD) mouse model. They found that the 24(S)-Saringosterol-containing sea vegetable, Sargassum fusiforme extracted by lipid activates liver X receptors β (LXRβ). They also elucidated that dietary supplementation of crude Sargassum fusiforme to AD mice significantly improved short-term memory and reduced hippocampal Aβ plaque load by 81%.[93]

Kim et al. reported antibacterial activity of Phlorotannins from edible brown algae, Eisenia bicyclis, against streptomycin-resistant listeria monocytogenes. They evaluated an effectiveness against listeria monocytogenes infection, a life-threatening condition like meningitis and encephalitis, and advocated that the anti-listeria activity of various phlorotannin isolated from E. bicycles was in the range of 16–256 mg/ml.[64,105]

The fucoidan standard from Sigma (Fstd, ≥95, CAS: 9072-19-9), fucoidan crude extract (WH), >300 kDa fraction (300k) and <10 kDa fraction (10k) were compared in terms of chemical composition and antioxidant capacity. They found that the primary antioxidant ability of the 10k is significantly higher than that of the 300k, but the secondary antioxidant capabilities of the 10k and 300k were similar, and both were higher than that of the butylated hydroxyanisole (BHA).[96,106]

The antiviral activity of fucoidan from Cladosiphon okamuranus against Newcastle disease virus (NDV) was reported by Elizondo-Gonzalez et al. They found that Fucoidan exhibited antiviral activity against Newcastle disease virus La Sota (NDV virus strain), with an obtained IS_{50} >2000.[98] It is reported by Ratnayake et al. that sea lettuce exhibits a multiorgan protector activities from oxidative and inflammatory stress by enhancing the endogenous antioxidant defense system.[100] Preez et al. investigated dry Caulerpa (C) lentillifera called "sea grapes" containing insoluble fibers in rats and found that C lentillifera attenuated cardiovascular and metabolic symptoms possibly by preventing infiltration of inflammatory cells together with modulating gut microbiota.[101]

Lee H et al. investigated the immune restoration activity of Undaria pinnatifida fucoidan-rich extract by using cyclophosphamide-induced immunosuppressed mice. They found that Undaria pinnatifida fucoidan-rich extract recovers immunity of immunosuppressed mice.[129]

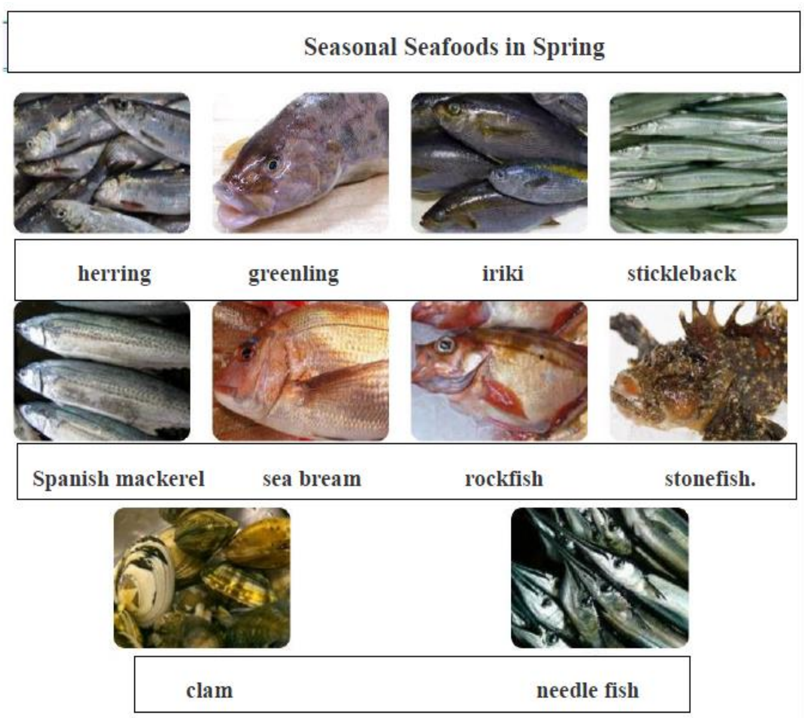
Lee J et al. assessed the antiviral potency of the fucoidan by examining the effects on the growth of three host cell lines and six viruses. The 50% inhibitory concentrations of the fucoidan for cell growth (CC_{50}) were higher than 2000 mg/ml against all tested cell lines. The 50% inhibitory concentration of the fucoidan for virus replication (IC_{50}) of HSV-1, HSV-2, HCMV were 2.5, 1.5, and 15 mg/ml, respectively, under conditions in which the fucoidan was added at the same time as viral infection. They postulated that antiviral principle in Mekabu may be a sulfated polysaccharide since Mekabu fucoidan possess potent antiviral efficiencies against various enveloped viruses.[94]

Lee D et al. investigated the immune-enhancing effects of polysaccharides extracted from Gloiopeltis furcate and found that macrophage activation induced by polysaccharides ≥100 kDa was greater than that induced by polysaccharides ≤10 kDa. They concluded that the polysaccharides ≥100 kDa extracted from Gloiopeltis furcata are potentially useful as natural immune-enhancing agents.[97]

3.3 FISH

Table 11: Medicinal benefits of fish.

NO	Medicinal issue	Medicinal benefits [reference]
1	life span benefit	[109] Fish oil enriched in docosahexaenoic acid dramatically extended life span of weanling mice.
2	medicinal activity	[110],[111],[112] antioxidant and antibacterial effect


Seasonal Seafoods in Spring
herring
greenling
iriki
stickleback
Spanish mackerel
sea bream
rockfish
stonefish.
clam
needle fish

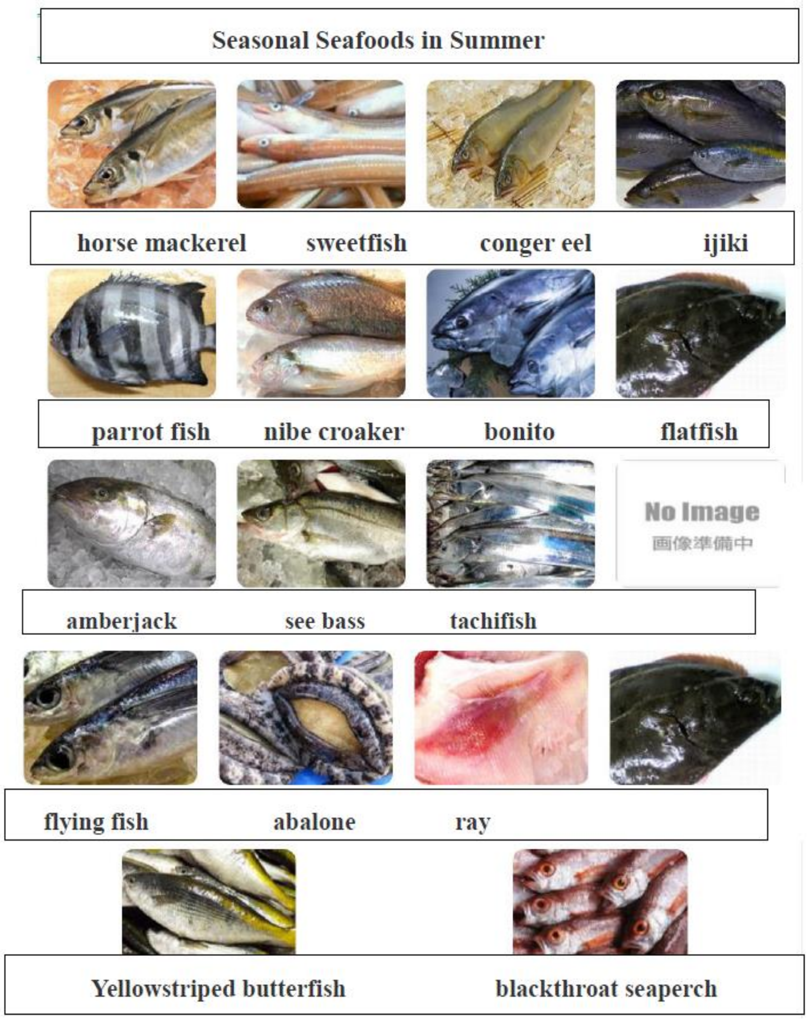

Seasonal Seafoods in Summer
horse mackerel
sweetfish
conger eel
ijiki
parrot fish
nibe croaker
bonito
flatfish
No Image
画像準備中
amberjack
see bass
tachifish
flying fish
abalone
ray
Yellowstriped butterfish
blackthroat seaperch

Figure 8: A list of edible fishes.

Note: Cited with permission from "home page of "Marketing fish and shell list by Houzu-Konnyaku ompany".[113,114]

Table 12: Food component values of essential food ingredients per 100g edible part of fish.[115]

name	sodium (mg)	potassium(mg)	calcium(mg)	magnesium(mg)	phosphate(mg)	iron (mg)	zinc(mg)	copper(mg)	mangan(mg)	iodine(µg)	selenium(µg)	chromium(µg)	molybdenum(µg)
herring, raw	110	350	27	33	240	1.0	1.1	0.09	0.02	-	-	-	-
horse mackerel, raw	130	360	66	34	230	0.6	1.1	0.07	0.01	20	46	1	0
saury	140	200	28	28	180	1.4	0.8	0.12	0.02	22	32	2	1
salmon	66	350	14	28	240	0.5	0.5	0.07	0.01	5	31	1	0

name	Retinol (µg)	β-Carotin(µg)	Act. Retinol(µg)	Vitamin D(µg)	Vitamin E (mg)	Vitamin K(µg)	Vitamin B1(mg)	Vitamin B2(mg)	Niacin(mg)	Vitamin B6(mg)	Vitamin B12(µg)	Folic acid (µg)	Pantothenic (mg)	Biotin(µg)	Vitamin C(mg)
herring, raw	18	0	18	22.0	3.1	(0)	0.01	0.23	7.3	0.42	17.0	13	1.06	-	Tr
horse mackerel, raw	7	0	7	8.9	0.6	Tr	0.13	0.13	9.2	0.03	7.1	5	0.41	3.3	Tr
saury	16	0	16	16.6	1.7	1	0.01	0.28	11.0	0.54	16.0	15	0.74	7.4	0
salmon	11	(0)	11	32.0	1.2	(0)	0.15	0.21	11.0	0.64	5.9	20	1.27	9.0	1

	Energy (Kcal)	Protein (g)	Triacylglycerol (g)	Saturated (g)	n-3 unsaturated (g)	n-6 unsaturated (g)	Cholesterol (mg)	Plant fiber (g)	Organic acids (g)	Carbohydrate (g)	Ash content (g)
herring, raw	196	14.8	13.1	2.97	2.13	0.26	68	(0)	-	4.7	1.3
horse mackerel, raw	112	16.8	3.5	1.10	1.05	0.13	68	(0)	-	3.3	1.3
Saury	287	16.3	22.7	4.87	5.59	0.55	68	(0)	-	4.4	1.0
Salmon	124	18.9	3.7	0.80	0.82	0.07	59	(0)	-	3.9	1.2

Lie et al. reported their findings from the first national nutrition follow-up study on fish consumption and severely depressed mood. They recruited 5068 adults aged 25–74 years examined in 1971–1975 as the baseline of the First National Health and Nutrition Examination Survey Follow-up Study using a 3-month food frequency questionnaire. Compared with frequent consumers (more than once a week), the odds ratios (ORs) were 1.43 (95%CI = 0.66–3.11) and 2.08 (1.08–4.09) respectively for the men eating fish once a week and less than once a week (p for trend = 0.03). Among women (n = 3029), the percentage of individuals with severely depressed mood (SDM) was 17.89%. The ORs were 1 (reference), 0.91 (0.68–1.22) and 1.15 (0.83–1.59) respectively for the women eating fish more than once, once, and less than once a week respectively. And they concluded that independently from social deprivation and physical diseases, low fish consumption was a risk factor for SDM among men.[108]

Norat et al. conducted the European prospective investigation into colorectal cancer risk and nutrition based on meat, fish and meat intake. They followed 478 040 men and women from 10 European countries who were free of cancer at enrollment between 1992 and 1998. After a mean follow-up of 4.8 years, 1329 colorectal cancer incidences were documented. Colorectal cancer risk was positively associated with intake of red and processed meat (highest [>160 g/day] versus lowest [<20 g/day] intake, HR = 1.35, 95% CI = 0.96 to 1.88; P trend = .03) and inversely associated with intake of fish (>80 g/day versus <10 g/day, HR = 0.69, 95 % CI = 0.54 to 0.88; P trend<.001). They concluded that colorectal cancer risk is positively associated with high consumption of red and processed meat and support an inverse association with fish intake.[116]

Sobieckiab et al. conducted the EPIC-Oxford cohort study by recruiting more than 65,000 participants of 20 years or older between 1993 and 1999. The participants are a cohort of generally health-conscious British residents adhering to 4 distinct dietary patterns: meat eaters, fish eaters, vegetarians, and vegans. Vegetarian and especially vegan diets appeared to be most protective against cardiometabolic diseases, based on their high fiber content and favorable fatty acids composition. The study highlighted the possibility of a high prevalence of inadequate intakes of some nutrients among vegetarians and vegans (vitamin B12, iodine, and possibly zinc and selenium), which emphasizes the importance of using fortified foods and/or nutritional supplements, as well as appropriate food choices to ensure adequate intakes of these nutrients.[117]

Harade et al. investigated the efficacy on survival against inflammatory kidney disease in a well-established animal model of systemic lupus erythematosus. Fish oil enriched in docosahexaenoic acid (FO-DHA) dramatically extends both the median (658 d) and maximal (848 d) life span of weanling (NZB 3 NZW)F1 (B 3 W) mice. Investigations into possible survival mechanisms revealed that FO-DHA lowers serum anti-dsDNA antibody, IgG deposition in kidneys, and proteinuria. Further, FO-DHA lowered lipopolysaccharide -mediated increases in serum IL (interleukin) -18 levels and caspase-1–dependent cleavage of pro–IL-18 to mature IL-18 in kidneys.[109]

Kac et al. determined the antibacterial and antioxidant activities of essential oils against Pseudomonas species isolated from freshwater fish by applying disc diffusion method. Among various essential oils Cymbopogon nardus, Origanum vulgare, Foeniculum vulgare and Thymus serpyllum showed the highest antioxidant activity of 93.86 lg, 83.47 lg, 76.74 lg and 74.28 lg TEAC/mL.[112,118]

Martinez et al. reported antioxidant and antimicrobial activities of rosemary, pomegranate olive extracts in fish patties measured as volatile compounds. They elucidated that fish patties made with these natural extracts showed lower volatile compounds related to lipid oxidation throughout the 11 days of storage under retail condition.[111]

4.4 JAPANESE TRADITIONAL FOOD ITEMS

Table 13: Japanese traditional foods and their characteristics.

name	Health benefits [reference]
tofu	[119] attenuate breast cancer risk [120] antioxidant activity and slight immunogenicity [121] Detected anticarcinogenic and antioxidant activities
natto (fermented soy bean)	[122,125] inhibits viral infections. [123,127] high-γ-PGA natto might suppress blood glucose elevations
soy sauce	[124] neuroprotective and antioxidant activities
Green tea	[126] anticancer mechanisms [56] antioxidant properties of matcha (fine powder tea) [52] nutritious and inner beauty effect

Table 13 shows Japanese traditional foods and their characteristics.[52]

(a) tofu

Wang et al. pursued a meta-analysis of observatory studies and mentioned that tofu intake is inversely associated with risk of breast cancer. Dose-response analysis based on 5 case-control studies revealed that each 10 g/d increase in tofu intake was associated with 10% reduction in the risk of breast cancer (95% CI 7%–13%, P = 0.037).[119]

Huang et al. demonstrated that the incorporation of tofu influenced the pores, swelling, water vapor transmission and compressive properties of hydrogels greatly. The antioxidant activities of hydrogels had been enhanced with increasing rations of tofu, and the fibroblast culture showed good proliferation on the hybrid hydrogels, as well as slight immunogenicity, thereby inducing the M2 differentiation of macrophages. Furthermore, a full-thickness skin wound model was created to study the healing effect of hybrid hydrogels. In vivo results confirmed that the antioxidant activity and slight immunological stimulation properties of tofu hydrogels could accelerate the wound healing rate and improve the skin tissue regeneration effect.[120]

Tuvar et al. found that a dried tofu- supplemented diet affects mRNA expression of inflammatory cytokines in human blood and they detected bioactive ingredients present in soy such as its protein, n-3 fatty acids, steroids, lignans, and phytate. These compounds have been shown to have beneficial bioactivity, mostly anticarcinogenic, and antioxidant. In addition, soy proteins, steroids and n-3 fatty acids have been shown to have immune moderator effect.[121]

(b) natto

Natto, a traditional Japanese fermented soybean food, is well known to be nutritious and beneficial for health. Oba et al. examined whether natto impairs infection by viruses, such as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as well as bovine herpesvirus 1 (BHV-1), and found both SARS-CoV-2 and BHV-1 treated with a natto extract were fully inhibited. They also found that the glycoprotein D of BHV-1 was shown to be degraded by Western blot analysis and that a recombinant SARS-CoV-2 receptor-binding domain (RBD) was proteolytically degraded when incubated with the natto extract. In addition, RBD protein carrying a point mutation (UK variant N501Y) was also degraded by the natto extract. When the natto extract was heated at 100 C for 10 min, the ability of both SARS-CoV-2 and BHV-1 to infect the cells was restored. Thus, they mentioned that their findings provide the first evidence that the natto extract contains a protease(s) that inhibits viral infection through the proteolysis of the viral proteins.[123]

Agaki et al. performed a randomized crossover study on healthy volunteers aged 20–64 years in order to investigate the effect of gamma-polyglutamic acid (γ-PGA)-rich natto consumption on postprandial glycemic excursion in humans. Blood samples were obtained at each visit before and for 120 min after loading. The incremental area under the curve (IAUC) of blood glucose and insulin levels was calculated and compared among the test meals. The blood glucose's incremental area under the curve (IAUC) at 0–120 min, the primary endpoint, was 20.1% and 15.4% lower for the high- and low-γ-PGA natto meal than for the white rice (WR), with a significant difference only between the high-γ-PGA natto meal and WR ($p < 0.05$). The blood glucose's IAUC at 0–15, 0–30, and 0–45 min was lower for the high-γ-PGA natto meal than for the low-γ-PGA natto meal (all $p < 0.05$). The possibility that high-γ-PGA natto might suppress blood glucose elevations in the early phase after eating is indicated.[123]

Araki et al. conducted a randomized crossover study in which they found that gamma-polyglutamic acid (GPA)-rich natto suppresses postprandial blood glucose response in the early phase after meals. They also found that the incremental area under the curve (IAUC) for blood glucose and insulin after the high PGA meal were lower than those after the low PGA meal within 45 min (0 to 15 and 0 to 30 min: $p < 0.001$, 0 to 45 min: $p < 0.01$) and 1 h (all $p < 0.001$) of loading. The suppressive effects of high PGA natto on postprandial glucose response in the early phase, which possibly relates to the risk of dysglycemia and cardiovascular disease, were clarified.[126]

Pinontoan et al. isolated from natto B. subtilis G8 new bacterial strain which has proven to exert fibrinolytic activity. B. subtilis G8 was able to lyse blood clots, presumably due to its ability of directly lyse fibrin. Furthermore, a crude extract of B. subtilis G8 displayed six zymogram brands of approximately 42.0, 35.5, 30.8, 26.7, 20.6, and 13.7 kDa, with the strongest activity observed at 20.0. They concluded that a crude extract of B. subtilis G8 has potent fibrinolytic activity and that the activity was mediated by various fibrinolytic enzymes.[127]

(c) Soy sauce

Jeong et al. reported neuroprotective and antioxidant activities of bamboo salt soy sauce (BSSS) in rat cortical neurons. They used a hydrogen peroxide (H_2O_2)‑induced neuronal cell death rat model and the rat neuronal cells were pretreated with various concentrations (0.001, 0.01, 0.1, 1 and 10%) of BSSS. The neuronal cells pretreated with BSSS exhibited increased cell viability, as compared with non‑treated neuronal cells. Furthermore, neuronal cells pretreated with 0.01% BSSS exhibited the greatest increase in viability.[124]

(d) Green tea

Green tea (Camellia sinesis) is well known for its anticancer and anti-inflammatory activities. Recent scientific research indicates that the number of hydroxyl groups and the presence of characteristic structural groups have a major impact on the antioxidant activity of catechins. Catechins exhibit the strong property of neutralizing reactive oxygen and nitrogen species. The group of green tea catechin derivatives includes: epicatechin, epigallocatechin, epicatechin gallate and epigallocatechin gallate. Furthermore, tea catechins are widely described to be efficient in the prevention of lung cancer, breast cancer, esophageal cancer, stomach cancer, liver cancer and prostate cancer. Notably, molecular signaling pathways of green tea catechol involve the additional inhibition of insulin-like growth factor-I (IGF I)-mediated signal transduction pathway. As evidenced, green tea catechins significantly reduce IGF-I protein levels in prostate cancer animal models. Available literature data indicate that polyphenols derived from green tea exert their antitumor activity due to modification of histones, micro-RNA as well as DNA methylation.[128]

Matcha exhibits antioxidant properties characterized by not only rutin, but also polyphenols and vitamin C. and its infusions have a high antioxidant potential, the highest out of all tea types.[129,130] Jakubczyk et al. studied on matcha green tea to examine antioxidant properties and nutritional composition. Matcha tea is characterized by a high level of antioxidant substances (flavonoids 1968.8 mg/L; polyphenols 1765.1 mg/L; vitamin C 44.8 mg/L). Furthermore, Matcha exhibit antioxidant potential (41.2% DPPH (10× dilution)) and 6129.5 μM Fe(II)/dm3 FRAP. The concentration range of these compounds depends on the time at which the matcha plant was harvested as well as on the infusion temperature to prepare the tea. They elucidated that for most parameters, the highest values were observed in infusions prepared at 90 ℃ from the daily Matcha.[131]

(e) Ume

Ume tree has been grown for more than 2000 years in Japan because of its health enhancing effects, and through innovative cultivation, the Japanese have improved the Ume tree to produce healthier fruits. Adachi et al. studied anticancer effect of ume and found that when the ume extract was added to the cancer cells the cancer cells were dose dependently eliminated at < 5 μL/mL. The Ume preparation showed no toxic effect on normal human.[130]

Son et al. elucidated that Prunus mume ripen seed (PmRS) exhibited protective effect against ultra-violet (UV) induced skin aging in mice through the conformation of phenotype indications, increased collagen levels and decreased skin sickness. In addition, the protective effect of PmRS treatment against UVB mediated cell viability was exhibited without any cytotoxicity in vitro.[132]

Kone et al. pursued a cross-sectional epidemiological pilot study to examine the association between ume intake frequency and allergic symptoms including rhinitis in 563 adults (288 men and 275 women). The result of the study indicated that women with high ume intake had significantly lower odds ratio (OR) for the allergy symptoms [OR: 0.49 with 95% confidence interval (CI): 0.25–0.97]. They further investigated the antiallergic effect of ume on passive cutaneous anaphylaxis (PCA) reaction by using immunoglobulin E (IgE)- sensitized mice. They elucidated that oral administration of ume extract attenuated the PCA reaction and mast cell degranulation. They concluded that ume has the potential to inhibit mast cell degranulation and may be associated with reduced risk of allergic symptoms in women.[18, 133]

Kim et al. studied protective effect of Prunus mume (PM) juice fermented with Lactobacillus plantarum and L. casein (FP) in colitis-induced mice model. They found that the administration of FP reduced lipid peroxidation and histopathological colitis symptoms such as shortening of the colon length, depletion of mucin, and alleviation of epithelial injury.[134,129] Enomoto et al. studied inhibitory effects of Japanese apricot, ume, on helicobacter pylori-related chronic gastritis, and elucidated that a preventive effect of ume inhibit H. pylori infection and reduce active mucosal inflammation.[135]

Talcot et al. reported the clinical outcome of the basidiomycetes Agoricus bulazei murill for the treatment of Japanese consumers with cancer and mentioned that the consumers felt favorable perceived effects. They identified two conceptually and empirically distinct and internally consistent summary scales measuring consumers' perception of the effect of the basidiomycetes Agoricus bulazei murill.[16]

Yano et al. investigated whether odor components contained in seasonings could stimulate the human motor functions. They recruited 72 subjects, and allotted them into three groups, 24 each. They are randomly assigned to a water exposure group, a phenylethyl alcohol (PEA, pleasant rose like odor), and a Japanese soy source exposure group. Epidemiological survey indicates the alleviation of clinical prostate cancer is attributed to high consumption of soybean derived food in which phytoestrogens have numerous anti-cancer properties. Polllard et al. pursued an experiment by using Lobunt-Wister rats (L-W) by feeding, a) commercial diet with soy meal, b) soy free diet. They are inherently predisposed to develop induced and spontaneous metastasizing adenocarcinomas. Fourteen months later, 17/58 (29.3%) of the latter rats developed cancer and 5/50 (10%) for the former rats. They claimed that soy meal would prevent prostate-related cancer.[23]

4.5 OKINAWA VEGETABLES

Okinawa enjoys the longest life span. One of characteristics of their life style is a practice of eating various kinds of plants in origin. Those include wormwood which can be used as an antiemetic, hemostatic, or insecticide, snake gourd which can be used as diuretic, aloe which can be used as stomatic or astringent, and so on. Table 15 shows 20 nutrition-rich vegetable fruits and nutritional characteristics.

For thousands of years, functional food plants are nature's gift to human beings to help them battle against various ailments. There is an increasing demand for functional plants in the world's diet.[136-138] It is considered that a compelling diet is an important factor for maintaining health and preventing diseases.[139] Dietary evidence and analysis have elucidated that the typical Japanese dietary pattern is characterized by high intakes of vegetables, fruits, soy products, mushrooms, sea vegetables and fish.[138-142]

This vegetable dietary-pattern is observed in Okinawa. Longevity effect in Okinawa is considered to be a result of traditional low calory diet.[143] Okinawa residents harvest and eat unique vegetables rich in vitamins and minerals. Table 15 lists some of those Okinawa vegetables. For example, there is a long history of using Gyruna (G) bicolor not only as a vegetable but also as a medicinal herb. It has been found in G. bicolor that there is a broad spectrum of nutrients and plant bioactives. G. bicolor has been acknowledged by local people as a useful source of medicine for several therapeutic treatments. It is expected that the current paper will encourage further research thereby contributing to open avenues for scientific applications of G. bicolor as a valuable plant with multiple health benefits.[142]

Table 14: A list of Okinawa vegetables with nutritional characteristics and effectiveness.[140, 144-146]

NO	Name	Nutritional characteristics	Effectiveness
1	Gyrura bicolor	functional food containing vitamins, minerals, and other useful source of medicine for various therapeutic treatments.	exhibit antioxidant activities and anti-hyperglycemic effects
2	bitter gourd,	vitamin C	appetizer
3	loofaf, Luffa cyrindrica	Vitamins and minerals	beauty effects
4	winged bean, Psophocarpus tetragolobus	Vitamin A_1 and C, K, β-Carotene	Antioxidant
5	Brassica juncer	K, Fe, vitamins	Antioxidant/peroxynitrite scavenging activity
6	tsuken carrot, Cnidium japonicum	Vitamin A, C, B1, B2, B6, vegetable fiber	anti-inflammatory effects
7	island shallot, Allium chinense syn. Allium bakeri	Adenosine	recovery from fatigue
8	**purple yam, Dioscorea alata**	K, vitamins, minerals,	anti-oxidant, cholesterol suppressor
9	Lxeris dentata	K, Ca, vitamins	immune activation, collagen synthesis
10	vegetable papaya, Carica papaya L	K, vitamins	protein and fat degradation, diet promoter
11	island pumpkin	Vitamin A, B1, C,	cold prevention
12	sibuy	K, vitamin C	diuretic, appetizer
13	otaniwatari	taurine	recovery of liver function、 recovery from fatigue Improved blood flow
14	handama	Ca, Fe, carotene、 Vitamin A, Vitamin B2, Anthocyanins、	antioxidant, recovery from fatigue, beautiful and whitening skin effect, tired eye recovery,

tokado khuchima (peri-horned melon)

naverer (sachima)

bitter melon

tatamm (turnum)

yomitan's red potato

african spinach (sibillan)

hooch bar (ryukyu

native to achokcha/ caygua

sakuna /long life grass / chomeegusa

island okra

handama (kintoki grass / suzenjina)

Gyruna bicolor

Figure 9: A list of "Okinawan vegetables"

Note: The list is cited from "vegetables of Okinawa" which opens for anybody, not claiming copy right. https://okinawa-cafe.net/simaokura/

Sakai et al. conducted a case control study of lung cancer based on cross-sectional questionnaire in 673 patients at five general hospitals in Okinawa, Japan, from 1982 to 1987 in order to clarify the relationships of lung cancer to cigarette smoking and plant diet. They identified 17 major dietary plants and/or herbs by means of a questionnaire interview. The patients were grouped to 64 pairs consisting of a case or two controls. The case-control analysis of each of edible 17 plants based on 44 pairs demonstrated that the odds ratio of aloe was 0.5 (P<0.1).[24,25]

Elderly individuals with high blood pressure living in the northern part of Okinawa have been drinking Ishimaki tea which Is the extraction of dried stems and leaves of Ooitabi. From ancient times, Ishimaki tea is said to have antihypertensive effects. Many plants in Okinawa are rich in antioxidants, and four flavonoid glycosides, including rutin, have been identified in Ooitabi. Suzuki et al. conducted research in which among 3,814 check-up patients the volunteers (n =38) with upper boarder line high blood pressure and dyslipidemia were asked to drink approximately 200 – 300 mL ishimaki tea a day. They concluded that Ooitabi extract can improve blood pressure and lipid abnormalities and has likely contributed to the longevity of the population in Okinawa.[147]

1. overview

World Health Organization (WHO) conducted WHO-coordinated Cardiovascular and Alimentation Comparison study and found that the intake of isoflavone (I; biomarker for dietary soy) and taurine (T; biomarker for fish) are inversely related to coronary heart disease (CHD) mortality. Japanese showed high level of these biomarkers and their CHD mortality is lowest among developed countries.[22]

Edible phytoestrogens are commonly found in fruits and vegetables. One of flavonoid known as phytoestrogen is Kaempferol which is a yellow compound found in grapes, broccoli and yellow fruits. It has been shown that Kaempferol may be involved in the regulation of cell cycle metastasis, angiogenesis, apoptosis in various cell types. Observation has suggested that Kaempferol may have antioxidant and anti-inflammatory effects. Kaempferol has been elucidated to have a biphasic effect, i. e. anticancer effect at higher concentration and pro-cancer activity at lower concentration.[26,27, 148,149]

The Japanese traditional diet (*Washoku*), which is characterized by high consumption of fish and soybean products with low consumption of animal fat and meat, are accompanied by the effective use of umami taste to enhance palatability. There may be a link between *Washoku* and the longevity of the people in Japan.[150] In addition another scientific basis is reported for the longevity of Japanese in relation to diet and nutrition.[151] The author sincerely wishes that the people in the world take into consideration the Japanese diet for their well-being. It is important to visualize the food items in order to clearly recognize them through eye sites. For that in his mind, the author paid attention to list the food items through images as much as possible. This visualization further vindicates that Japanese dishes are sometime considered as art which increase the appetite and promote digestion leading to help create the healthy human being.

CONCLUSION

1. The length of life expectancy and healthy life expectancy in Japan have risen in the past few decades. Both figures are longest in the world: life expectancy for male and female together is 84.4 years old in 2019 or nearest, and healthy life expectancy is 74.00 years old in 2019 or nearest, Not only remarkable outcome of life expectancy and healthy life expectancy, but also mortality elucidated a significant consequence in which Japan showed the lowest mortality for all-causes: the rate standardized per 100,000 population is 556 in Japan and the average rate of 38 OECD countries is 770, While various factors such as universal coverage of health insurance, socioeconomic and cultural effects have been considered to improve health status of Japanese population, special attention should be paid to the fact that dietary effect contribute significantly for outstanding upshots. Those dietary contribution includes not only the role of the modern Japanese diet, which has been improved in terms of nutritional balance due to the economic development, but also the traditional dietary habit which includes high intakes of fish, variety of vegetables, see vegetable products, mushroom products and soybean products and low intake of fat products.
2. So many species in each food group exist in Japan. As far as the number of species pointed out in this paper is concerned, the numbers of species in mushroom, see vegetable, fish, and Okinawa vegetable are 11, 11, 56 and 28 respectively. The species on many of food groups change as the season alternate. It can be said that Japanese tend to pick up the first product of the season as a habit. As we observed by referring to Japan Food Ingredient Table,[120] nutritious items are different from one species to another within the food group. Besides, medicinal effects such as anti-inflammatory effect, antioxidant effect, immune system moderation effect, and antihypertensive effect are different from one species to another. Therefore, it is important to eat as many different food items as possible.
3. Unique food items distinctive to Japan such as natto, ume, tohu, green tea, and soy source play characteristic roles not only for health effect but also for palatable effect.
4. The evidences of healthy food in Japan have been shown from the standpoint of unique food groups. And it is shown to be distinct evidence that each group contains abundant species which represent unique and nutrient ingredients. There is no question about the profound relationship between Japanese diet and top levels of life span and healthy life span. The author strongly hope that Japanese diet will contribute to enhance the health status of the people in the world providing that the demerits of Japanese food should be disregarded.

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