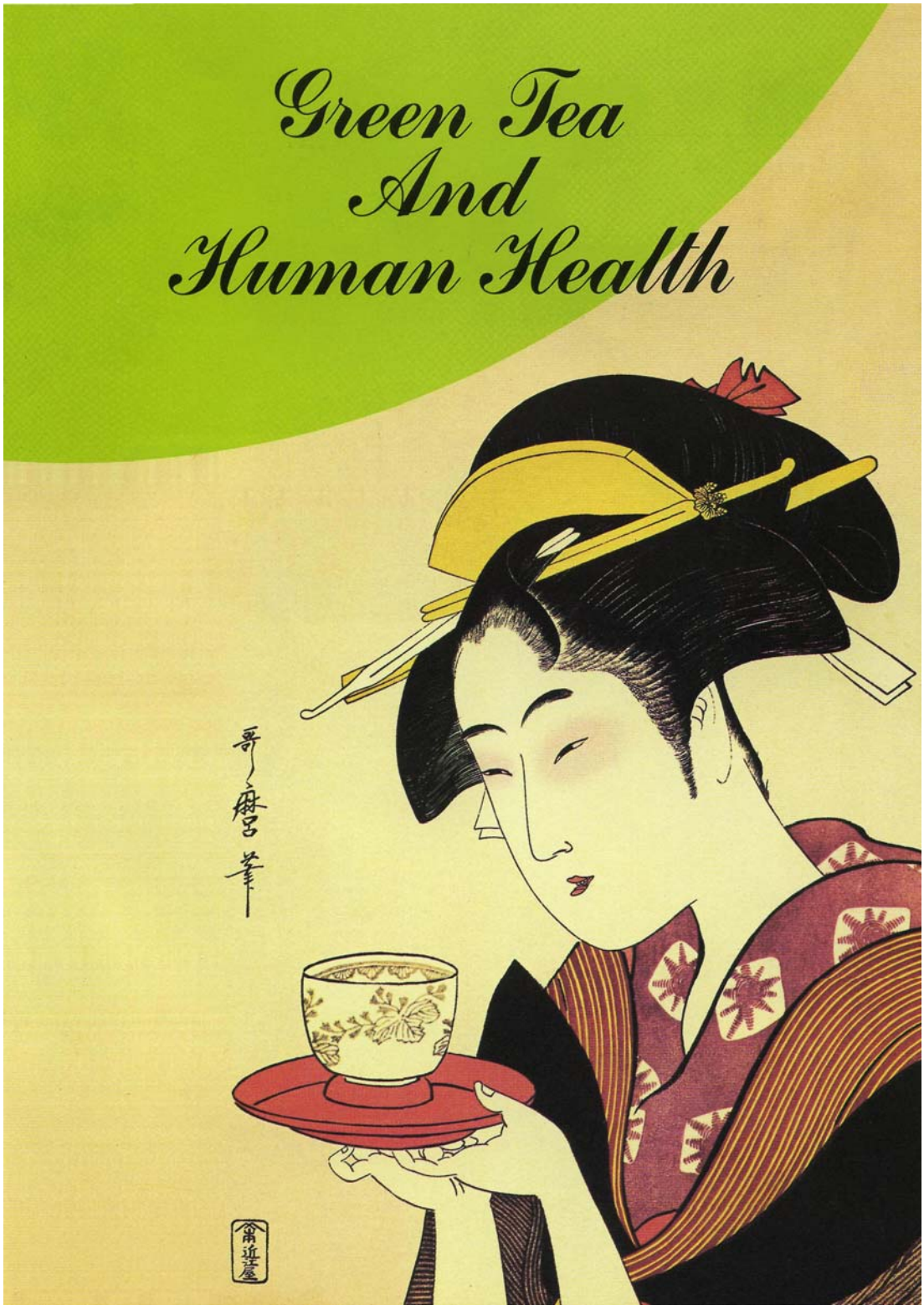
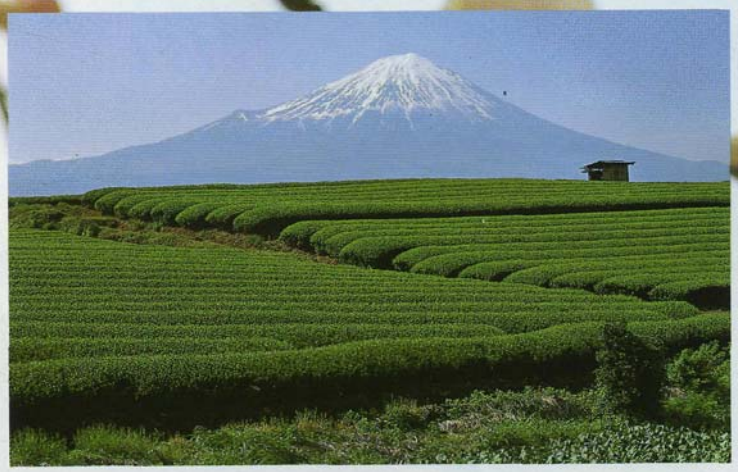
Green Tea And Human Health





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Green tea and health ~ a cup of green tea enhances health~

The Japanese custom of drinking green tea came from China about 800 AD. The use of tea started when Buddhist monks, who had gone to China for study, returned to Japan bringing tea with them as a medicinal beverage. In the Kamakura era (1191-1333), the monk Eisai stressed the beneficial effects of tea in his book *Maintaining Health by Drinking Tea* (1211): "Tea is a miraculous medicine for the maintenance of health. Tea has an extraordinary power to prolong life. Anywhere a person cultivates tea, long life will follow. In ancient and modern times, tea is the elixir that creates the mountain-dwelling immortal." From this passage we can see that green tea has from early times been highly valued as a powerful medication. But in recent years research into the effects of green tea has progressed so far it can now provide scientific confirmation for the legendary saying that "Tea is a miraculous medicine for the maintenance of health." It is becoming increasingly clear that green tea has a broad efficacy in preventing disease. The remainder of this brochure will introduce you to the main points of the research summarized in the "The Components and Healthy Effects of Green Tea." (Table 1) [1)]

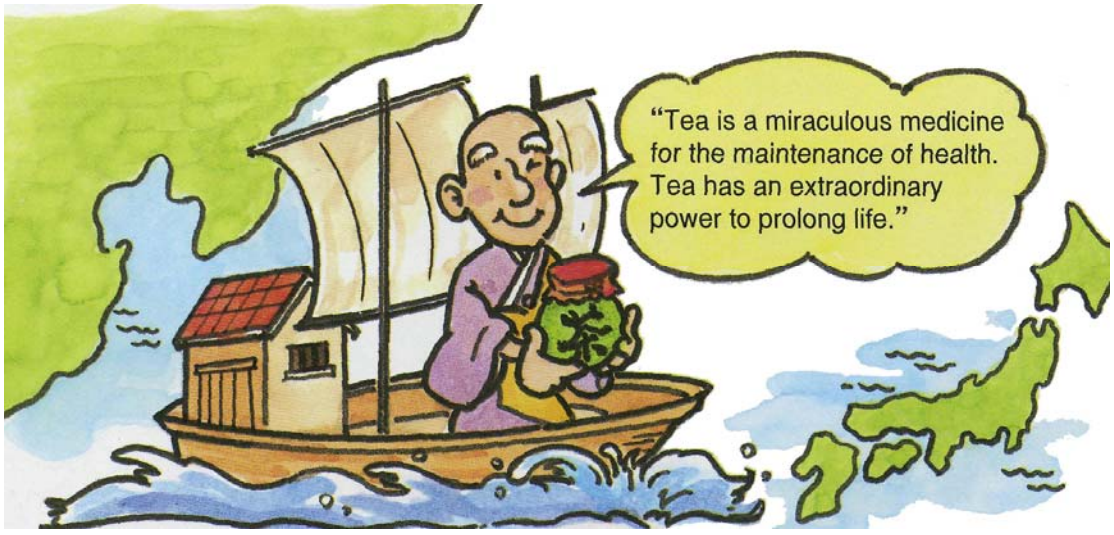


Table 1 The Components and Healthy Effects of Green Tea

Components of Green	Healthy Effects
Catechins (Main component)	Reduces incidence of cancer Reduces tumors Reduces mutations Reduces oxidation by active oxygen Lowers blood cholesterol Inhibits increase of blood pressure Inhibits increase of blood sugar Kills bacteria Kills influenza virus Fights cariogenic bacteria Prevents halitosis
Caffeine	Stimulates wakefulness (removes fatigue and sleepiness) Acts as diuretic
Vitamin C	Reduces stress Prevents flu
Vitamin B Complex	Aids carbohydrate metabolism
γ - Amino Butyric Acid (GABA)	Lowers blood pressure
Flavonoids	Strengthen blood vessel walls Prevents halitosis
Polysaccharides	Lowers blood sugar
Fluoride	Prevents cavities
Vitamin E	Acts as antioxidant and regulates aging
Theanine (a kind of amino acid)	Gives green tea its delicious taste

1) I.Oguni and Y.Hara, "*Green tea has many medicinal activities for preventing disease such as cancer, cardio-vascular diseases and diabetes*". (published by The Chunichi-shinbun, Nagoya, Japan), PP.1-239(1990).

Green tea prevents cancer

Cancer mortality statistics on Japanese people indicate that the death rate from cancer is significantly lower, for both men and women, in Shizuoka Prefecture. This fact stimulated our interest in cancer prevention and led us to calculate the death rate (Standardized Mortality Ratio) by cancer type for every city, town and village in Shizuoka Prefecture. Based on these death ratio statistics, we created a cancer distribution map of the Prefecture and examined it in detail for trends. We found that areas devoted to green tea production in the central and western regions of Shizuoka Prefecture exhibit a significantly lower death rate for all types of cancer in general and for gastrointestinal cancers such as stomach,

esophagus and liver cancer in particular.[2] We then made a survey to see how the residents of the green tea producing regions, which have such low cancer death rates, drink their tea. The results showed that those who live in areas where green tea is the staple crop tend to drink it daily in rather strong concentrations by frequently refreshing the tea leaves in their pots.[2,3] From these results we theorized that green tea must be connected in some way with cancer prevention, and we decided to continue our research with animal experiments.

Mice were first inoculated with cancer cells and then studied for the growth of malignancies. One group was given an extract of green tea while another control group was not given such an extract. Comparison of the two groups showed a marked reduction in the growth of tumors among the group receiving green tea (Table2).[4] In further joint research with Prof. Shu-Jun Cheng of the Cancer Institute, Chinese Academy of Medical Science (Beijing), mice were given substances which, when transformed in the body to cancer-causing chemicals, generate carcinoma in both the esophagus and fore stomach. The researchers then proceeded to check if green tea has the ability to inhibit the development of these cancers. Administration of green tea extract did indeed reduce the incidence of cancer to less than 50% (Table 3).[5] In addition, research at the National Cancer Institute (Tsukiji, Tokyo) has demonstrated that administration of catechin (the main component of green tea tannin) to mice previously given chemicals that induce duodenal cancer can also significantly lower the incidence of cancer. Green tea and its component catechin have, therefore, been shown to reduce the growth as well as the actual generation of cancer.[3]

2) I.Oguni et al., *Japanese J. of Nutrition,* **47**, 31 (1989).

3) I.Oguni, *Metabolism and Disease,* **29**, 453, (1992).

Table 2 Inhibitory Effect of Crude Green Tea Extracts on the Growth of Mouse Sarcoma 180 Tumor

	Dose (mg/kg/day)	Average Tumor Weight [a] (g)	Inhibition Ratio (%)
Control	—	2.04 ± 0.82	—
Extracts	200p.o.X4	1.85 ± 1.34	9.3
	400p.o.X4	1.02 ± 0.20	50.0 [b]
	800p.o.X4	0.82 ± 0.55	59.8 [c]
Mitomycin C	2i.p.X4	0.37 ± 0.20	81.9 [c]

a) The means ±S.E. b) $p<0.05$ c) $p<0.01$

The crude extracts of green tea leaves were daily administered to ICR mice orally for 4 days after subcutaneous inoculation of sarcoma 180 cells ($1X10^7$ cells / mouse). Mitomycin C was used as a positive control. Tumor weight was compared with that of the control (10 mice / group) on the 21st day after inoculation.

Table 3 Inhibitory Effect of Green Tea Extract on the Induction of Tumors in Mice by *in vivo* Formation of Nitrososarcosine from its Precursors, Sarcosine and Sodium nitrite

Group	Treatment	No. of Mice	Incidence of Esophageal Papilloma(%)	Incidence of Carcinoma (%)		
				Esophagus	Fore stomach	Total
I	Sarcosine + NaNO2	47	33 (70.2)	3	16	19 (40.4)
II	GTE + Sarcosine + NaNO2	45	20 (44.4) [a]	0	8	8 (17.8) [a]

a) $p < 0.05$ GTE : Green Tea Extract

Green tea extract (5mg/mouse/day) was incubated to mice (Tientsin II, female) 6 times a week, for 14 weeks. From the second week, mice of both Group I and II were incubated with sarcosine ethyl ester hydrochloride (2g/kg) and sodium nitrite (0.3g/kg) 3 times a week, for total 5 weeks. The animals were sacrificed at the 14th week.

4) I.Oguni et al., *Agric. Biol. Chem.,* **52**, 1879 (1988).

5) I.Oguni and Shujun Cheng, *Annual Report of The Skylark Food Science Institute,* **No.3**, 57 (1991)

From our previous epidemiological research we can estimate that the inhabitants of the midwestern region of Shizuoka Prefecture, where green tea is the staple product and main beverage, consume as much as 1.0 - 1.5g of crude green tea catechins daily in their green tea. This strongly suggests that green tea catechin plays a role in their low SMR (Standardized Mortality Ratio) for stomach cancer.

We do not yet fully understand the mechanism underlying the generation of cancer, but it involves at least the following two stages (Fig.l). This is called the "two-stage theory of cancer development." A substance capable of causing mutations (initiator) first damages DNA in the cell and renders it subject to cancer (initiation). This condition then remains unchanged for some time until another substance, which activates cancer (promoter), leads to the actual growth of a malignancy (promotion). It is clear from recent research that extract of green tea and catechin can markedly inhibit both stages of development.[6)]

Even though these results have been gained from animal studies or pure laboratory tests, we think it highly significant that green tea and its component catechin have the ability to prevent cancer. When taken together with the survey that indicates a striking reduction in the cancer death rate in the tea producing regions where the residents are accustomed to drinking quite strong tea by frequent changes of tea leaves, they support the conclusion that green tea may also be a factor in the prevention of human cancer.

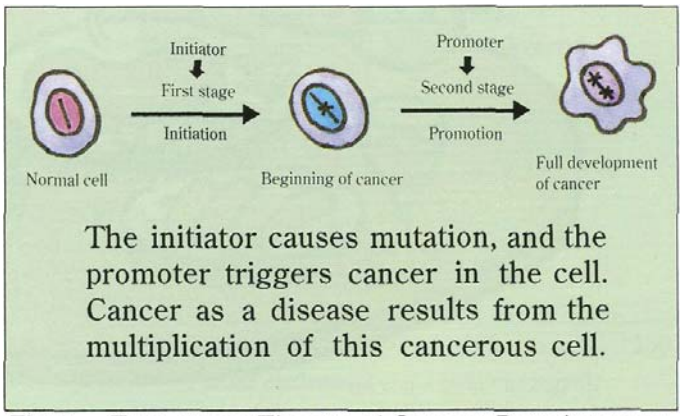


Fig.1 Tow-stage Theory of Cancer Development

6) Y.Nakamura et al., *Proc. of International Tea-Quality-Human Health Symposium,* pp.227-238 (Hangzhou, China, November, 1987).

Green tea restricts the increase of blood cholesterol

Cholesterol is always indicted as the "bad guy" for causing a wide range of diseases in adults. But it is a chemical present in all animals and crucial in human bodies for such important processes as the manufacture of cell membranes and the adhesion of cells. There are two types of cholesterol: one is the so-called "bad" cholesterol (LDL and VLDL-cholesterol) that accumulates in tissues and the other is the "good" cholesterol (HDL-Cholesterol) that collects excessive cholesterol from the tissues. If the amount of bad cholesterol in the blood increases too much,

7) K.Muramatsu and Y.Hara, J.*Nutr. Sci. Vitaminol*., **32**, 613 (1986).

8) K.Goto, S.Kanaya and Y.Hara, *Proc. of the International Symp. on Tea Science*, 314(Shizuoka, Japan; August, 1991).

it is deposited on the walls blood vessels and can lead to atherosclerosis. Atherosclerosis in conjunction with high blood pressure can cause myocardial infarction and cerebral infarction. Good cholesterol, however, prevents atherosclerosis and must exist in a proper balance with bad cholesterol for proper health.

Prof. Muramatsu, [7] has demonstrated in experiments with rats that green tea catechin restricts the excessive buildup of blood cholesterol. When rats were fed a diet high in fat, the amount of bad cholesterol in the blood increased rapidly. But the addition of only 1% catechin to the food checked the increase of bad cholesterol (LDL) with only minimal effect on the amount of good cholesterol (HDL) (Fig.2). In another series of experiments, rats fed normal food with catechin exhibited no decrease in blood cholesterol and remained unaffected by the supplement. We can see from these results that green tea catechin acts to limit the excessive rise in blood cholesterol. Recently Dr.Goto [8] reported similar results for human blood cholesterol.

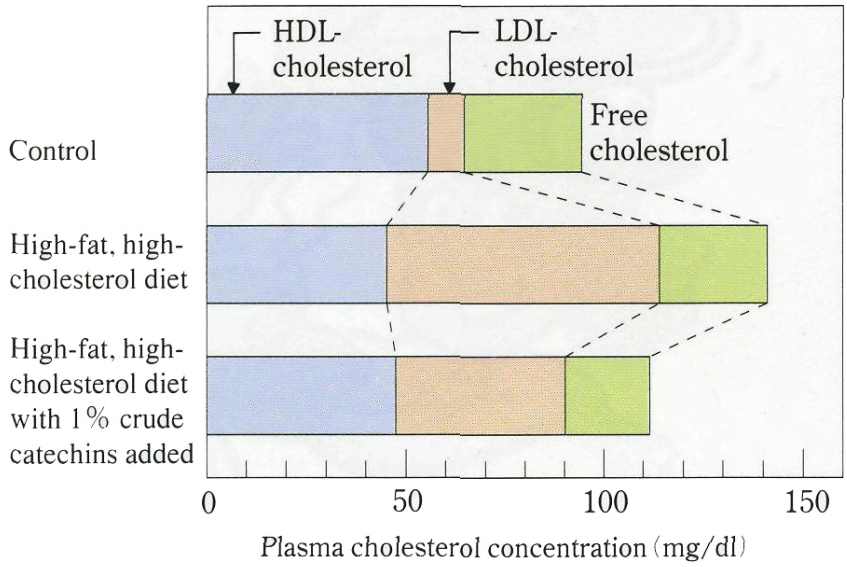
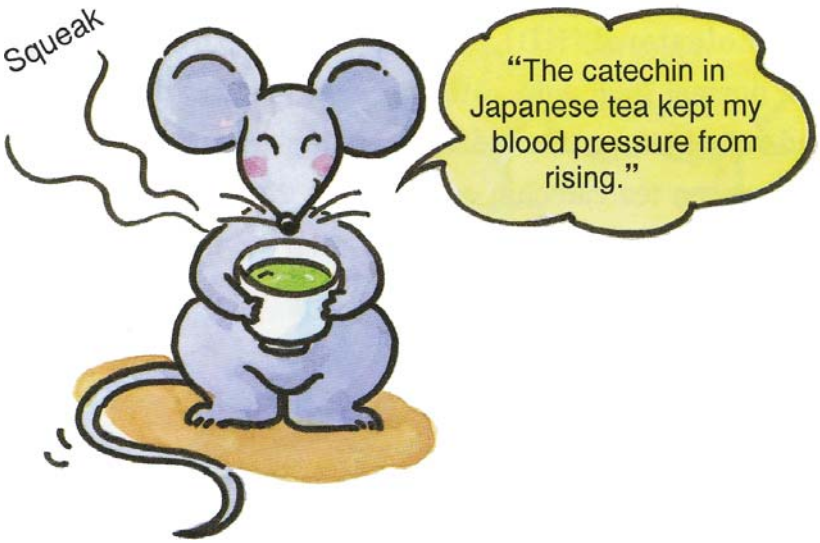


Fig.2 Hypocholesterolemic effect of "crude catechins"

Green tea controls high blood pressure

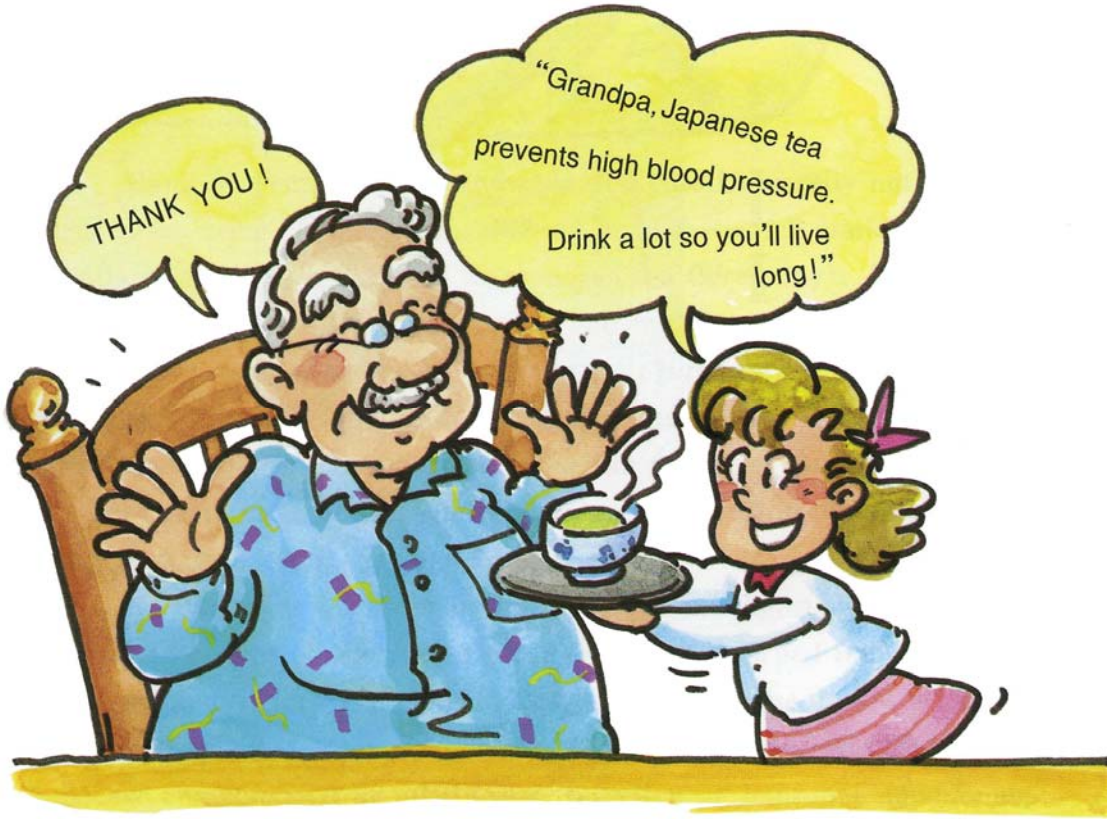
High blood pressure places a serious burden on the vascular system and contributes to atherosclerosis. Atherosclerosis will in turn precipitate heart disease, stroke and other cardiovascular diseases. The cause of high blood pressure is not yet fully understood, but it is clear that a chemical called angiotensin II plays a role in high blood pressure due to essential hypertension and to arterial stenosis of the kidneys. Blood contains the substance angiotensinogen which is transformed to angiotensin I under action of the enzyme rennin in the kidneys. Another enzyme called the "Angiotensin Converting Enzyme" (ACE) then changes angiotensin I to angiotensin II, which is an extremely strong vascular constrictor. It is the



9) Y.Hara, T.Matsuzaki and T.Suzuki, *Nippon Nogeikagaku Kaishi*, **61**, 803 (1987).

constriction of the blood vessels caused by this constrictor that leads to high blood pressure.

Dr.Hara [9] has shown that green tea catechin impedes the action of ACE and suppresses production of angiotensin II. He has also demonstrated that administration of catechin to Spontaneously Hypertensive Rat (SHR) could limit increases in the rats' blood pressure. SHR are rats used as models for human high blood pressure experiments, and their blood pressure at the start of the experiment (when they were five weeks old) was 130 - 140mmHg. By the age of about 10 weeks, after a diet of normal feed, their blood pressure had risen to more than 200mmHg. But the blood pressure of



those rats raised with 0.5% catechin added to their feed remained below 200mmHg. Exchanging the feed of the two rat groups at 16 weeks of age led to a reversal in blood pressure between the two groups (Fig.3). These results indicate that green tea catechin has the ability to prevent a rise in blood pressure. If the amount of catechin used in this experiment is converted to the amount of green tea normally drunk by humans, it is equivalent to drinking about 10 moderately large cups of tea per day.

These are surely quite significant results in suggesting, as they do, that the daily consumption of green tea can prevent high blood pressure.

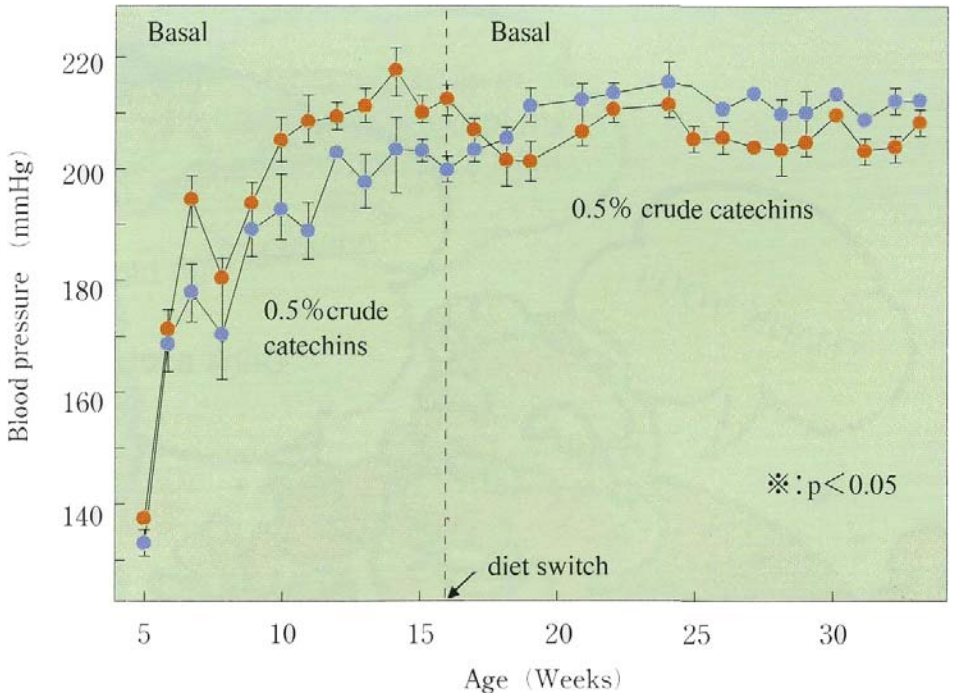
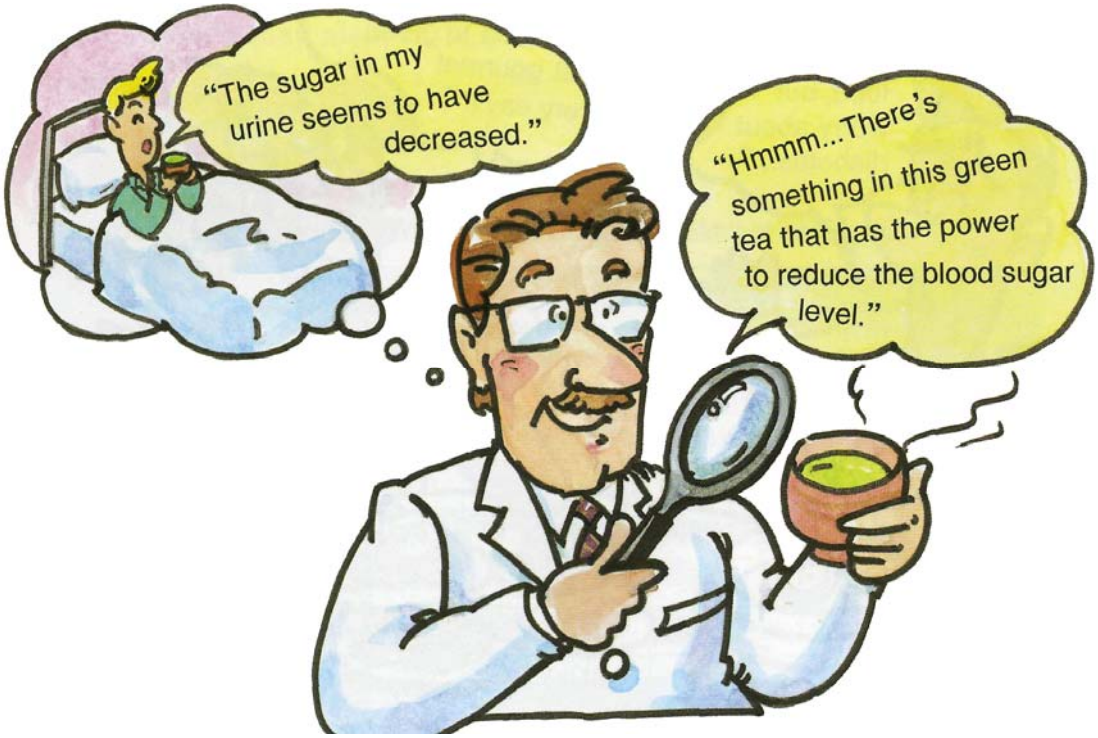


Fig.3　Effect of crude catechin on blood pressure of SHR

Green tea lowers the blood sugar level



About 60 year ago, Dr.Minowada of Kyoto University noticed that sugar in the urine of patients hospitalized for diabetes fell markedly during periods when they participated in chanoyu (Tea Ceremony). He reported that powdered tea of the type used in the traditional Tea Ceremony had the capability of lowering blood sugar. Unfortunately, however, this important report was ignored due to the outbreak of World War II and the subsequent postwar food shortages. But the arrival of the "gourmet era" in recent years in Japan has led to heightened interest in diabetes and the ability of green tea to reduce blood sugar.

The sugars and carbohydrate in our food are digested mainly in the duodenum, converted there to glucose and then absorbed into the blood. The agent that regulates the intake of blood sugar into the tissues is insulin, a chemical secreted from Lange Hans islets on the pancreas. Diabetes is a disease characterized by insufficient secretion or improper functioning

of insulin, which hinders the proper absorption of glucose into the tissues and leads to a high concentration of blood sugar that must eventually be excreted into the urine. If this high concentration of blood sugar should continue for a long period, it will affect the vascular system and cause a number of quite serious diseases including atherosclerosis and retinal hemorrhages. Dr.Hara [10)] gave dried green tea catechin in edible form to mice that were subject to hereditary diabetes and verified a lowering of their blood sugar. In parallel experiments, Dr.Shimizu [11)] gave an extract of green tea to mice and demonstrated that it had the ability to lower blood sugar (Table 4). It has also been shown that the polysaccharides in green tea possess the same ability. Although these results come from animal tests, the evidence that green tea catechin and polysaccharides can lower blood

sugar in mice may also, in light of Dr. Minowada's old report, apply to humans.

Table 4 Reduction of Blood Sugar by Extract of Tea

		Dosage (mg/kg)	Blood Sugar Level before Dosage (mg/dl)	Blood Sugar Level after Dosage (mg/dl)	Ratio of Reduction in Blood Sugar (%)	Evaluation
Control		0	430.3±10.8	357.3±35.7	17.0	-
			427.8±15.7	373.4±27.1	12.7	-
Tolbutamide 1)		600	434.1±13.6	370.0±30.8	14.8	-
Buformin l)		180	428.3±15.1	127.5±39.6	70.2	+ + +
Gyokuro	Cold water-soluble fraction	1500	436.0±13.5	285.2±15.1	34.6	+
	Warm water-soluble fraction	900	429.2±12.9	305.1±26.1	28.9	±
	Cold water-soluble fraction	700	437.2±13.9	315.0±26.2j	28.0	±
Sencha	Cold water-soluble fraction	1600	428.1±14.2	292.6±36.6	31.7	+
	Warm water-soluble fraction	1200	430.4±11.6	305.9±36.1	28.9	±
	Cold water-soluble fraction	700	427.9±12.2	307.8±34.6	28.1	±
Bancha	Cold water-soluble fraction	1400	441.0±17.2	265.5±44.2	39.8	+ +
	Warm water-soluble fraction	1200	426.8±12.0	365.9±18.0	14.3	-
	Cold water-soluble fraction	1000	425.6±14.9	321.8±34.8	24.4	±
Black tea	Cold water-soluble fraction	1000	437.0±14.4	352.2±38.2	19.4	-
	Warm water-soluble fraction	1200	428.3±14.2	315.2±23.4	26.4	±
	Cold water-soluble fraction	800	424.3±10.3	304.2±23.1	28.3	±
Powdered tea (Maccha)		1500	427.1±11.8	306.7±41.2	28.2	±

1) Synthetic blood glucose-lowering drug

2) Blood sugar reduction ratio greater than 35% = + +, 30 ~ 35% = +, 20 ~ 30% = ±, less than 20% = -

10) H.Asai, Y.Kuno, H.Ogawa, Y.Haraand K.Nakamura, Kiso to Rinsshyo, **21**, 163 (1987).

11) M.Shimizu el al., Yakugaku Zasshi, **108**, 964 (1988).

Green tea Suppresses aging

Oxygen is necessary for human life. But oxygen has two aspects, One beneficial and one malign. The oxygen we breathe is conveyed to every part of the body where it plays a key role in metabolism. But it can also be a very harmful agent in the form of active or free radical oxygen. Active oxygen is a problem because it can combine with anything in the body and oxidize it - with consequent destruction of cell membranes, damage to DNA

12) T.Okuda et al., *Chem. Pharm. Bull.*,**31**, 1625 (1983).

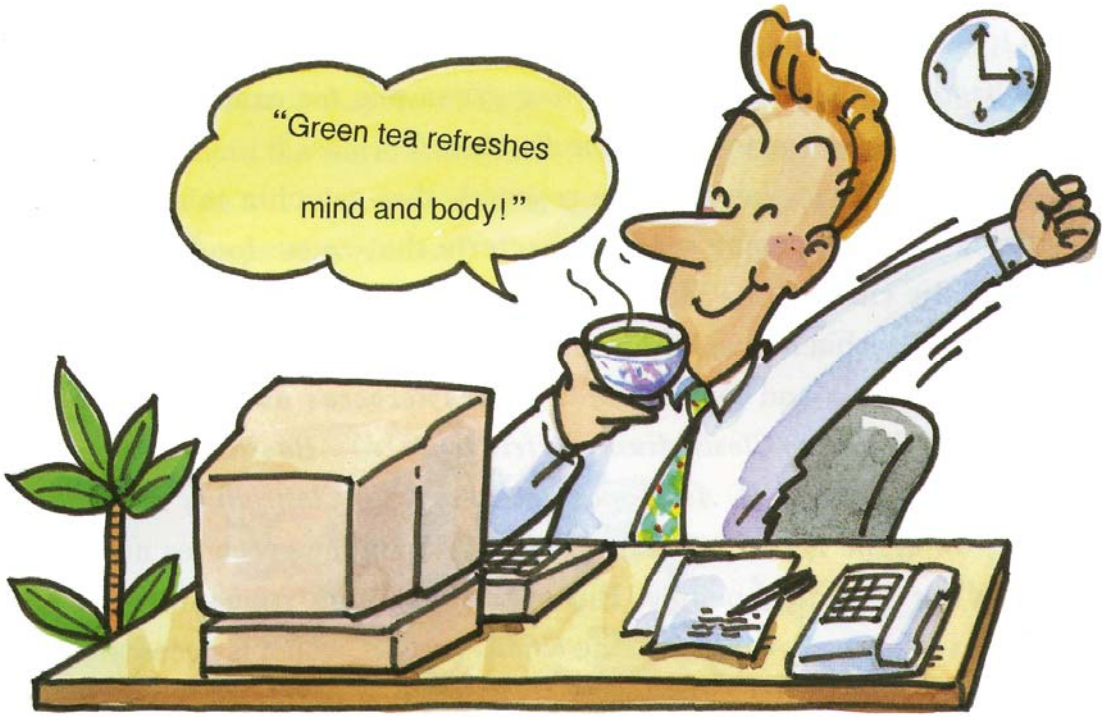
and oxidation of lipids (fats). All of these can lead to diseases like cancer. Here we shall focus on the process by which active oxygen combines with lipids (fats) in the body to create lipid peroxide, that is, lipid with an excessive amount of oxygen. Lipid peroxide is thought to be a harmful substance which can trigger the diseases such as cancer, cardio-vascular disease and diabetes. Since lipid peroxide is more easily generated and less easily purged as age advances, it tends to accumulate in the body. Lipofuscin, called the "aging pigment," also accumulates in the body in proportion to age and is considered to be an index of aging. But lipofuscin is itself created by lipid peroxide, which suggests a connection between aging and lipid peroxide. One way to slow aging may, therefore, be to prevent the production and accumulation of active oxygen and lipid peroxide in the body. It has been shown, for example, that the higher the concentration of the powerful antioxidants vitamins E and C in the bodies of animals, the longer they live. This suggests that active consumption of agents that are effective antioxidants will restrain the aging process.

We already know that green tea is rich in those vitamins that possess this antioxidizing capability. In addition, Prof. Okuda [12)] has recently demonstrated that catechin in green tea is a far stronger antioxidant than vitamin E (about 20 times stronger in fact). These results come from laboratory tests only, and we must wait for further research to confirm a direct cause and effect - relationship between the antioxidizing function of green tea and the retardation of aging. But the very fact that green tea contains a powerful antioxidant is a strong foundation for believing it can help control aging.

Green tea refreshes the body

Tea contains caffeine which, when taken in the proper quantity, stimulates every organ in the body. It has a particularly strong effect on the central nervous system, heart and liver. This reaction is even more pronounced when one is sleepy or tired. A cup of tea or coffee will help clear a dull mind after rising in the morning or after a prolonged period without sleep. The power to stimulate and awaken the mind comes from caffeine. It is also said that the amount of caffeine contained in normal servings of green tea can stimulate the skeletal muscles and facilitate muscular contraction. For this reason, it is quite helpful to drink tea or coffee in the middle of work to refresh the mind and restore the body. We find it noteworthy that there is some scientific support for such old customs as the afternoon snack, coffee break or tea time ritual.

The caffeine in green tea is mostly extracted in the first infusion of the leaves, but the quantities in subsequent infusions will still be greater



than coffee. And since green tea caffeine combines with catechin in the brewing water, its action is said to be rather milder than other caffeine-containing beverages. Even so, some people are sensitive to caffeine and cannot sleep if they drink green tea before going to bed. It is safer for such individuals to drink a weak green tea after dinner.

Why not treat yourself to a zestful day by enjoying the positive effects of mild caffeine with the sweet aroma of green tea ?

Green tea deters food poisoning

It has long been known from experience that green tea has the ability to kill bacteria. Consumption of strong green tea, for example, is often recommended as a good treatment for diarrhea.

Dr.Hara [13] has shown in his research that catechin is a powerful sterilizing agent for many types of bacteria that cause food poisoning (Table 5). He checked the Minimum Inhibitory Concentration (MIC, ppm) of green tea catechin neccessary to stop the growth of various types of food poisoning bacteria and found that (a) *Staphylococcus aureus*, (b) *Vibrio parahaemolyticus*, (c) *Clostridium perfringens*, (d) *Bacillus cereus*, (e) *Plesiomonas shigelloides*, (f) *Aeromonas sobria and* (g) *Clostridium botulinum* cannot grow in the 1/10 - 1/2 of 0.1% of catechin in the green tea normally drunk by the Japanese people. But even fairly high concentrations of catechin had no negative effect on the *bifidus bacillus*, which is necessary for proper functioning of the intestinal tract. In addition to this evidence, Prof. Shimamura [14] has reported that green tea is a very strong sterilant of *cholera vibrio* and has a strong antitoxic effect on toxins produced by bacteria other than cholera.

Table 5 Minimum inhibitory concentration (ppm) of tea catechins against some heat-resistant, spore-forming bacteria

Tea catechins	C. botulinum		B. subtilis		B. stearothermophilus		D. nigrificans	
	Spore	Vegetative cells	Spore	Vegetative cells	Spore	Vegetative cells	Spore	Vegetative cells
Crude Catechin	300	<100	>1000	>800	300	200	<100	>1000
EGC	>1000	300	>1000	>800	1000	300	500	>1000
EC	>1000	>1000	>1000	>800	>1000	800	500	>1000
EGCg	200	<100	1000	>800	200	200	200	>1000
ECg	200	200	900	>800	300	<100	<100	>1000
Crude theaflavins	200	200	600	700	300	200	<100	>1000

ECG : (–) -epigallocatechin gallate, EC : (–) -epicat-chin.

EGCg : (–) -epigallocatechin gallate, ECG : (–) -epicatechin gallate

These results indicate the antibacterial function of green tea catechin and suggest that it may be effective in preventing food poisoning. Every year throughout the world there are countless incidents of food poisoning.

Wouldn't it been a good idea, given these facts, to enjoy one's meals with several cups of green tea ?

13) Y.Hara and T.lshigami, *Nippon Shokuhin Kogyo Gakkaishi*, **36**, 996 (1989).

14) T.Shimamura et al.,*Jpn.J.Bacteriol*, **44**, 669 (1989).

Green tea stops cavities

Dental techniques have improved greatly in the past few years, but once teeth have been damaged by cavities they can never be restored to their original condition. It is of the highest priority, therefore, to prevent cavities from developing in the first place. By the end of the 19th century, it had been determined that caries are caused by cariogenic bacteria. The cariogenic bacteria first produce non-watersoluble glucan from sugar or other foods, and this glucan adheres to the tooth enamel as hard plaque. Next, they feed on sugar to generate acids such as lactic acid in the plaque. These acids then dissolve the tooth enamel. That in brief is the mechanism of cavity production. To prevent cavities it is necessary, then, to keep plaque

off the teeth by brushing - an important tool in good dental hygiene. But according to experiments by Dr.Hattori [15] green tea catechin can suppress the process (glucosyl transferase) by which cariogenic bacteria create glucan (Table 6). Other experiments by Dr.Sakanaka [16] have verified that green tea catechin can destroy cariogenic bacteria (Table 7). That is, it is antibacterial. Clearly, then, green tea catechin not only suppresses the formation of plaque by cariogenic bacteria but also kills the bacteria themselves.

It has been known for some time that small amounts of fluorine can strengthen teeth and help prevent cavities. For this reason, many cities

15) M.Hattori et al., *Ckem. Pharm., Bull*, **38**, 717 (1990).

16) S.Sakanaka et al., *Agric. Biol. Ckem*., **53**, 2307 (1989).

Table 6 Inhibitory effects of tea catechins on glucosyltransferase activity

Enzyme sources	6715DP		MT8148	GTase-I[a)]	MT8148	GTase-S[a)]
Test compounds [b)] conc., μg/ml	250	500	250	500	250	500
None	100	100	100	100	100	100
C	96.7	73.1	83.7	61.2	95.0	71.0
EC	85.4	71.2	81.4	72.1	50.9	43.8
GC	31.7	9.7	97.2	85.8	82.7	61.8
EGC	84.7	61.0	94.0	82.0	90.4	58.7
ECg	0	0	0	0	0	0
GCg	0	0	0	0	0	0
EGCg	0	0	0	0	0	0

a) GTase-I and GTase-S synthesized insoluble and soluble glucan, respectively

b) Test compounds : C, (+) -catechin; EC, (–) -epicatechin; GC, (+) -gallocatechin; EGC, (–)-epigallocatechin; ECg, (–) -epicatechin gallate; GCg, (–) -gallocatechin gallate; EGCg, (–) -epigallocatechin gallate

Table 7 Minimum inhibitory concentrations (MIC) of tea catechins against cariogenic bacteria

Test compounds [3)]	MIC(μg/ml)					
	S.mutans MT8148		S.mutans IFO13955		S.mutans 0715DP	
	a [1)]	b [2)]	a	b	a	b
C	>1000	>1000	>1000	>1000	>1000	>1000
EC	>1000	>1000	>1000	>1000	>1000	>1000
GC	250	250	250	250	250	250
EGC	500	250	500	250	500	250
ECg	>1000	1000	>1000	>1000	>1000	>1000
EGCg	1000	500	1000	500	1000	500

1) BHI agar medium

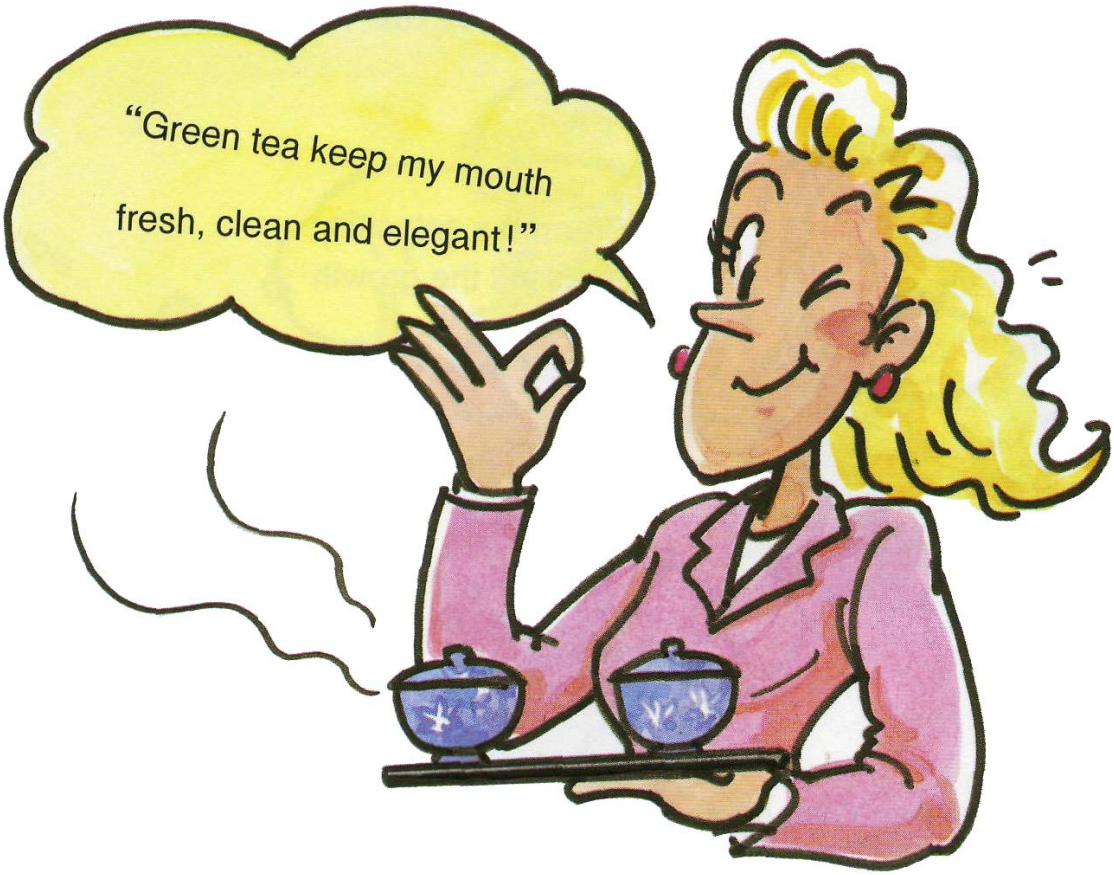
2) Sensitive meat extract agar medium

3) Test compounds : C, (+) -catechin; EC, (–) -epicatechin; GC, (+) -gallocatechin; EGC, (–) -epigallocatechin; ECg, (–) -epicatechin gallate; EGC, (–) -epigallocatechin gallate

add fluorine to their drinking water. Green tea, however, contains natural fluorine and is thought to help prevent cavities. That may explain those reports that show a reduction in cavities among grade school children who drank green tea after lunch.

Halitosis or bad breath embarrasses many people. It is caused by a number of bacteria that flourish in the mouth. Green tea can also kill other oral bacteria besides those causing caries. It has, therefore, some ability to prevent bad breath by destroying the cause of bad breath.

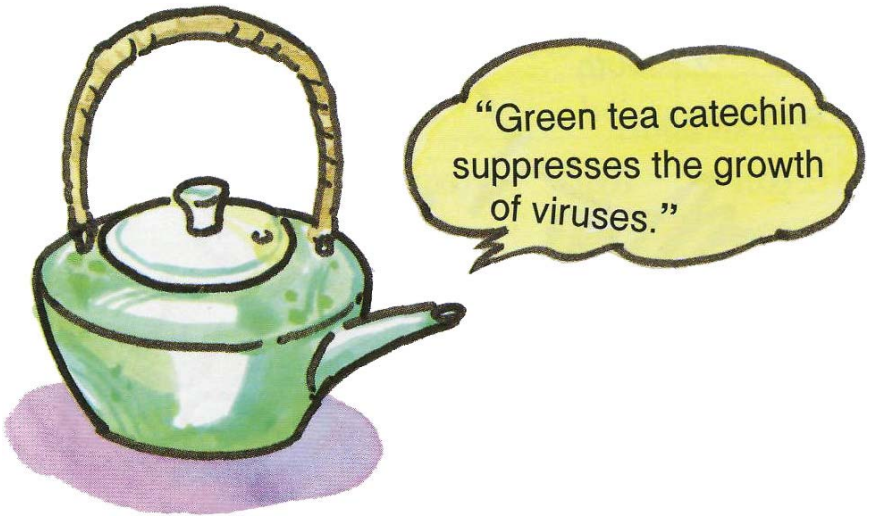
Why not enjoy gleaming white teeth and a fresh breath by drinking green tea?



Green tea fights virus

Dr. Okada [17] has noted the fact that tobacco growers use an exudates of green tea to prevent crop damage by the tobacco mosaic virus and verified that green tea catechin suppresses the growth of this virus. In addition, Prof. Shimamura [18] has determined that green tea catechin and theaflavin (an oxidized form of catechin) present in black tea have a strong effect on the influenza virus. Green tea catechin and black tea theaflavin directly act on the influenza virus and inactivate it. It appears, therefore, that gargling with green or black tea is very effective in preventing influenza. This effect is increased by keeping the green tea catechin and the virus in contact as long as possible.

It is also hoped that the antiviral capability of green tea catechin may have some beneficial effect on the AIDS (Acquired Immune Deficiency Syndrome) virus, which is now the world's most feared infectious disease. Dr. Nakane and Dr. Ono [19] at the Aichi Cancer Institute have verified the fact that green tea catechin can inhibit the activity of the AIDS virus in



17) F. Okada, *Chagyo Kenkyu Hokoku*, **48**, 52 (1978).

18) T.Shimamura et al., Lett, Appl. *Microbiol*., **11**, 38 (1990).

19) H.Nakane and K.Ono,*Biochemistry*, **29**, 2041 (1990).

laboratory test (Table 8). Although this research is just in its nascent stage, it provides a slight ray of hope that a treatment may someday be found to combat the now unstoppable AIDS virus. Future research advances in this field are expected.

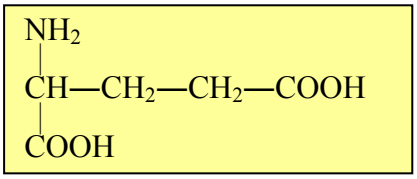
Table 8 Inhibitory effects of (-)-epicatechin gallate and(-)-epigallocatechin gallate on the activities of HIV-reverse transcriptase and various DNA and RNA polymerases (IC_{50} values in)

DNA and RNA polymerases	(-) -Epicatechin gallate	(-) -Epigallocatechin gallate
HIV-1 reverse transcriptase	0.017	0.012
DNA polymerase α	0.13	0.06
β	0.12	0.12
γ	0.9	0.6
E.coil RNA polymerase	0.25	0.13

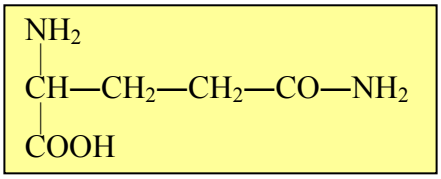
High quality Japanese green tea refreshes and stimulates your minds!

People feel a great peace of mind when sipping a cup of high quality Japanese green tea. Why dose high quality Japanese green tea make people relax although tea contains caffeine, which stimulates the central nervous system? Components in tea must have a key to the settlement of this contradiction. Theanine is the most abundant amino acid in Japanese green tea and it affects the quality of the taste of tea. Its chemical structure is similar to glutamine and glutamic acid, which are both neurotransmitters. So, Theanine may exert a physiological function in the brain.

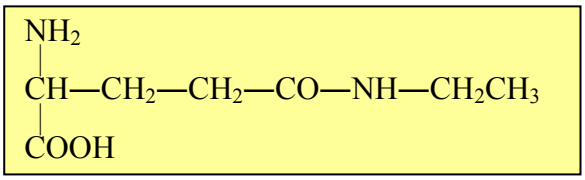
Glutamic acid



Glutamine



Theanine

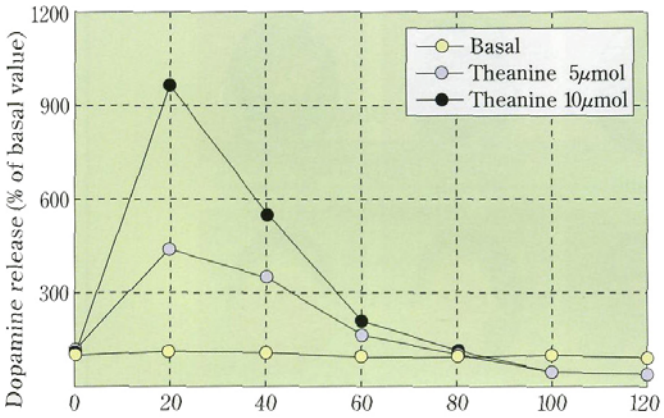


Amino acids in Japanese Sencha dry leaves mg/100g

	Mg/100g	Average	%
Theanine	**404-3122**	**1552**	**52.84**
Glutamic acid	208-376	257	8.75
Aspartic acid	116-681	278	9.47
Arginine	29.8-1233	395	13.45
Serine	60.3-524	241	8.21
Others	66.3-615.4	214	7.29
Total	**884.4-6551.4**	**2937**	**100.00**

According to recent research, Theanine is absorbed in the intestine and goes to the brain. Theanine in the brain gives a boost in releasing dopamine, which plays an important role in the action of neurotransmitters. Also, some chemical components, which control the blood pressure at the peripheral nervous system, are increased by the intake of Theanine.

Theanine is proved to diminish the risk of hypertension, since spontaneous hypertensive rats show a reduced blood pressure after a Theanine intake.



Fig, 2. Dose-dependent Theanine Stimulation of Dopamine Striatal

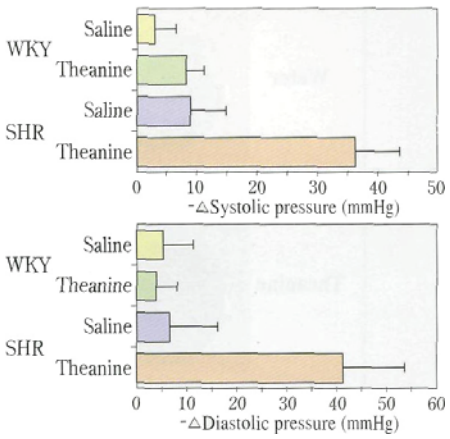
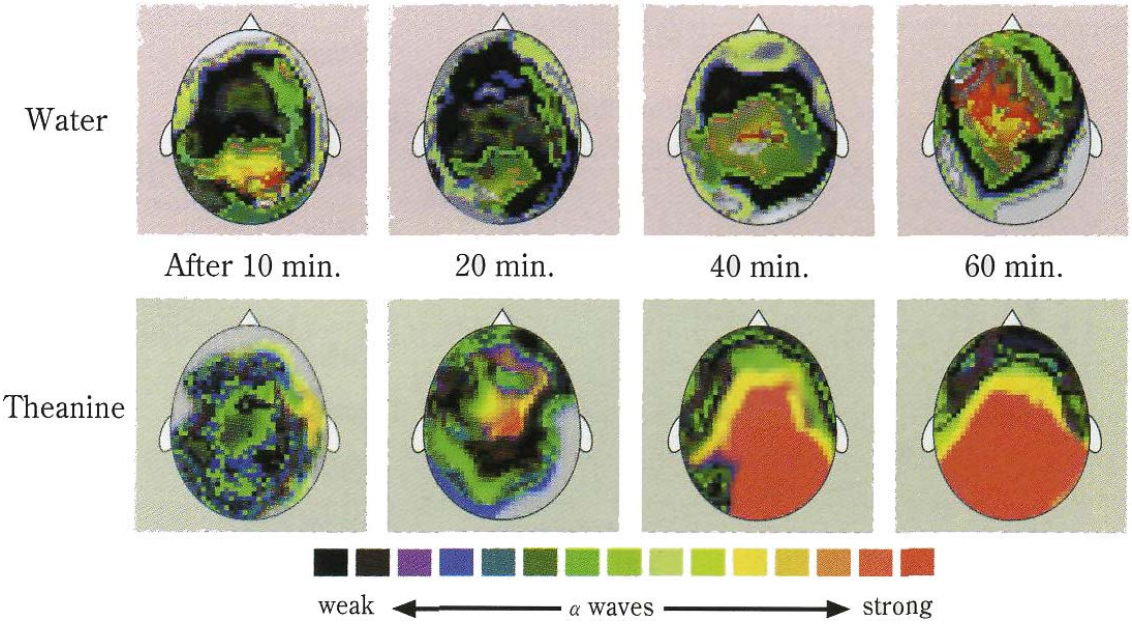


Fig. 3. Theanine Administration of the Decrease on Systolic and Diastolic Blood Pressure of Conscious Wistar Kyoto (WKY) and Spontaneously Hypertensive Rats(SHR)

On the other hand, Theanine also directly affects the functions of the neurotransmitters. So called α-brain waves, which are emitted in a relaxing human brain, are observed frequently and for a long period of time after a Theanine intake. Furthermore, scientists found that Theanine strengthens the memory ability.



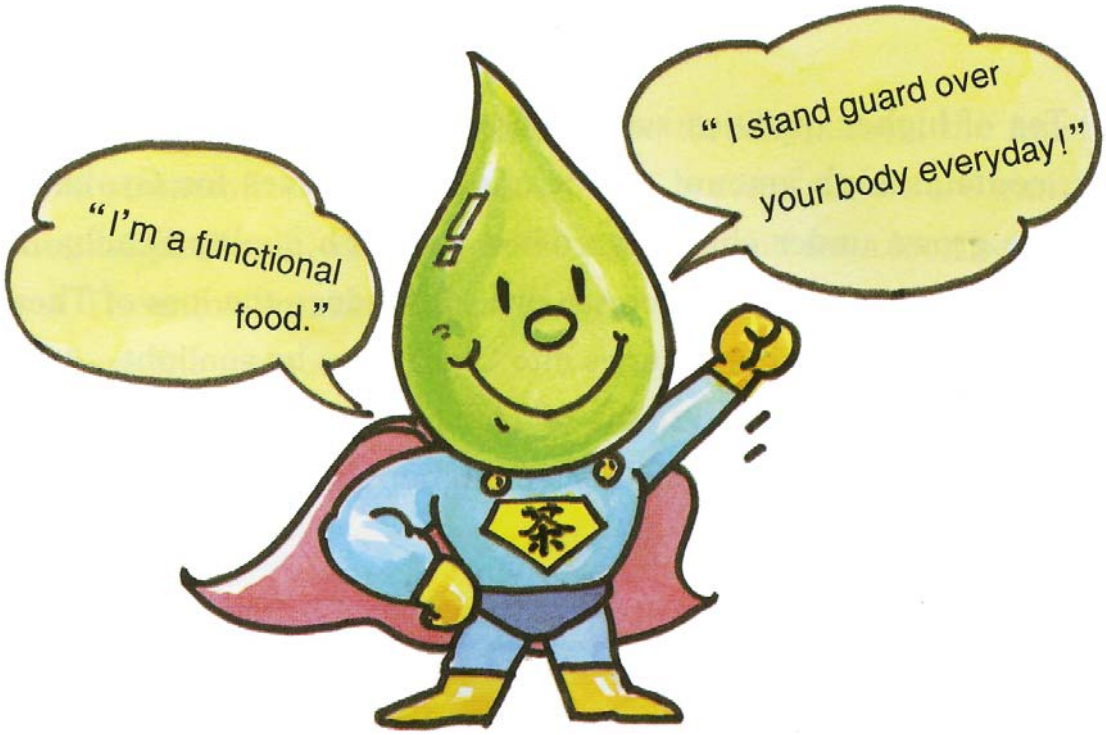
Tea of higher qualities such as Gyokuro, Matcha, and high quality Sencha, contains high amount of Theanine. Tea leaves for Gyokuro and Matcha are grown under shaded gardens, and high quality Sencha leaves are picked very young. This is done in order to reduce the loss of Theanine in tea leaves, since Theanine changes into Cathechins by sunlight.

So, all these positive effects of Theanine should show us, why we would better choose Japanese green tea of higher qualities.

Theanine in Dry Leaves (mg/l00g)

Gyokuro High quality	2650
Gyokuro Medium quality	1480
Gyokuro Low quality	1340
Sencha Premium quality	1980
Sencha High quality	1280
Sencha Medium quality	1210
Sencha Low quality	612
Bancha	-
Hojicha	-
Matcha High quality	2260
Matcha Medium quality	1790
Matcha Low quality	1170
Chinese White tea	838
Chinese Yellow tea	1580
Chinese Oolong tea	588
Chinese Pu-er tea	8

Green tea acts as a functional food



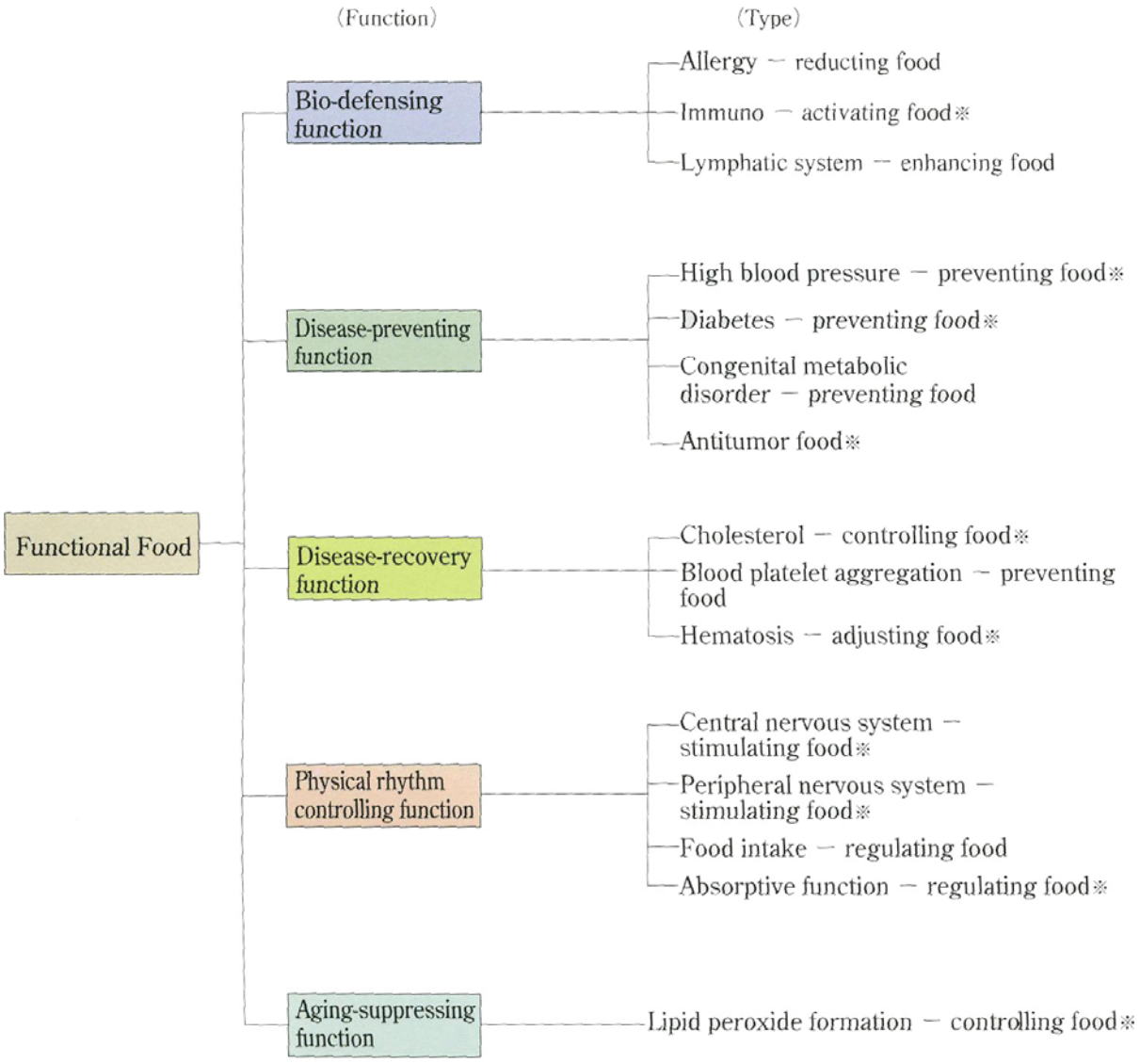
Discussions of food normally were focused on its nutritional content and its flavor. Recently, however, more attention is being paid to the role of food in bio-regulating functions. Foods that possess this regulatory function are called "functional food." Dr. Inaba[20] classifies food by function as shown in Table 9. If we classify green tea and green tea catechin according to this table, they possess the following functions : (l) bio-defensing function by preventing cancer through fortification of the immune system, (2) disease-preventing function by preventing high blood pressure or diabetes, (3) disease-recovery function by inhibiting the rise of cholesterol, (4) physical rhythm-controlling function by stimulating the central nervous system with caffeine and (5) aging-suppressing function by providing the body with antioxidants. Green tea is, therefore, rich in possibilities as a functional food and should prove a popular beverage among the new health conscious generation.

Green tea, with its sweet aroma and eternally fresh taste, has been loved and continuously drunk since its introduction to Japan centuries ago. But

20) H.Inaba, *Food Chemicals*, 4 (**No.1**), 33 (1988).

modern research has finally started to remove the veil concealing some of its true power as a functional food. Green tea is truly a "miraculous medicine" with an "extraordinary power to prolong life."

Table 9 Classification of Functional Food



* An asterisk marks a function for which tea is particularly efficacious.