






## University of Shizuoka : Past & Present

The University of Shizuoka, by absorbing various prefectural universities established in Shizuoka, came into being in 1987. It combined the **Shizuoka College of Pharmacology**, originally founded in 1916 as **Shizuoka Women's Pharmacology School**, along with **Shizuoka Women's University** and **Shizuoka Women's Junior College**.



## The University of Shizuoka's Aims

**Aims**  
The University of Shizuoka has the following aims for education, research, contributing to the community and international relations.

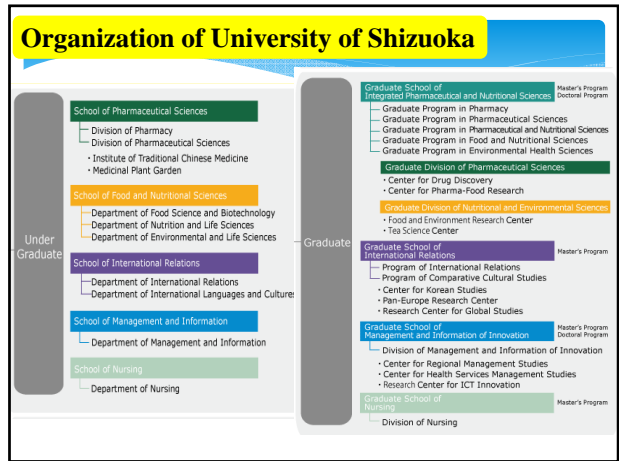
**Education**  
Putting students first, we will improve their quality of life and provide fine-tuned, high-level, excellent education, developing human resources who contribute to society.

**Research**  
Aware of being the highest educational institution in Shizuoka Prefecture, we will gather high-level, original academics and promote research that gets international recognition.

**Contributions to the Community**  
In response to citizen mandates, we will promote ties with the prefectural government and local industry, providing results to the community through research made possible by excellent education and academics.

**International Exchange**  
We will actively take in students and researchers from foreign countries, and by spreading information across the world, strongly promote international relations in Shizuoka Prefecture.

The University of Shizuoka aims to utilize academic and personnel resources to their maximum levels in order to achieve these goals.



## Research activities

Education and research leading to longer, healthier lives

Japan now faces a crisis in the form of a globally unprecedented super-aged society. This has necessitated a nationwide shift to a society in which healthy living is maintained even during old age. Shizuoka Prefecture ranks second among Japan's prefectures for "healthy life expectancy". As an educational and research institution of Shizuoka Prefecture, the University aims to establish a new academic discipline that spans preventative and therapeutic fields.



The University of Shizuoka was selected for the Global Centers of Excellence Program administered by the Japanese Ministry of Education, Culture, Sports, Science and Technology. As a result, the Graduate School of Nutritional and Environmental Sciences and the Graduate School of Pharmaceutical Sciences are working collaboratively on the development of functional health foods and pharmaceuticals for maintenance of health, improving nutrition, and increasing usage rates of efficient pharmaceuticals. The goal of this endeavor is to develop the framework for a new "science of health and longevity," a systematic academic discipline that integrates the nutritional and pharmaceutical sciences.



After the achievements earned over a decade of the COE program, in 2012 the University brought together the Graduate School of Nutritional and Environmental Sciences and the Graduate School of Pharmaceutical Sciences to form the Graduate School of Integrated Pharmaceutical and Nutritional Sciences. This key institution for "science of health and longevity" is currently fostering professionals who possess knowledge in both of the aforementioned fields.

**Research into tea**

Agriculture and fisheries developed early on in Shizuoka as a result of its temperate climate and rich natural surroundings. Tea cultivation is particularly worth noting in that crude tea grown in Shizuoka accounts for about 40 percent of all tea produced in Japan. Refined tea also accounts for about 60 percent. In an effort to contribute to one of Shizuoka's best known industries, the University of Shizuoka continues to conduct a university-wide range of studies on tea, covering such topics as the functional properties of tea, its potential to slow aging and prevent illness, and topics such as sales strategies and product development.



## Tea Science Center


*At the Tea Science Center, we teach about the health benefits of tea and pass on our knowledge about the best methods of cultivation, processing and marketing the various types of teas. The Center also collaborates extensively with other laboratories and organizations related to the tea industry*

Governmental agency

Public research center

University

Tea industry



Tea Science Center

Processing Genomics

Marketing Management study

Fermentation Chemistry Epidemiology

Tea Science Center

Functionality The science

## General Information of SHIZUOKA

Geographical Information

Population	3,765,007 (2010)
Area	7,780.42 km <sup>2</sup>
Ave. Temp.	16.5°C
Prefectural Capital	Shizuoka city

The Top 5 Main Agricultural Products(2015)

Rank	Products	Amount (mil JPY)
1	Tea	37,300
2	Tangerine (Mandarin Orange)	23,600
3	Rice	20,000
4	Hen's egg	13,800
5	Strawberry	10,800

Source: Ministry of Agriculture, Forestry and Fisheries

○ Geographical Information

○ The Top 5 Main Agricultural Products(2015)

## Shizuoka's Natural and Cultural Gallery of Landscapes

439 food items produced in Shizuoka

Total of 1,143 agriculture, forestry, and fisheries products

● Fujisan as a World Cultural Heritage (June 2013)

Fujisan from Miho Beach

Fujisan Hongu Sengen Taisha Shrine

## Shizuoka meeting global standards

● Izu Peninsula Geopark to join the Global Geoparks Network

Iritahama & Tatadotama Beaches (Shimada City)

Dougashima (Nishizu-cho)

● The Southern Alps as a UNESCO Eco Park

Southern Alps & Fujisan

Mount Akaishi

● Chagusaba as a Globally Important Agricultural Heritage System (GIAHS)

Awagatake (Kakegawa City)

Chagusaba  
Satoyama & rare plant species

## Green Tea Plantations in Shizuoka

**Shida**

Most of the tea plantations in Shida are located in the valleys of the Abe river, and the upper part of the Yamanote river.

**Shizuoka Honyama**

Honyama is located in a mountain valley which opens to the Abe river, and the upper part of the Yamanote river.

**Fuji-Nomazu**

The modern green tea plantations in Fuji and Nomazu started in the south-west of Mt. Fuji, and the western foot of Mt. Aohata.

**Kawane**

The green tea plantations in Kawane are located along a mountain valley in the upper part of the Ota river.

**Tenryu-Utsunomiya**

Chasen is located on the outskirts of Oshidaira. It is located on the borders of Maki-nohara and includes the Maki-nohara area.

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Chasen is located on the outskirts of Oshidaira. It is located on the borders of Maki-nohara and includes the Maki-nohara area.

**Maki-nohara**

The green tea plantations in Maki-nohara are among the largest in Japan. They spread to the steep coast plain of Ota, and were developed in the first year of the Meiji period (1868).

**Shimizu**

Shimizu is a source of green tea, which is centrally located on the mountain slopes of Mt. Nishidaira and the Ota river basin.

## Scene of tea fields

Conventional Field

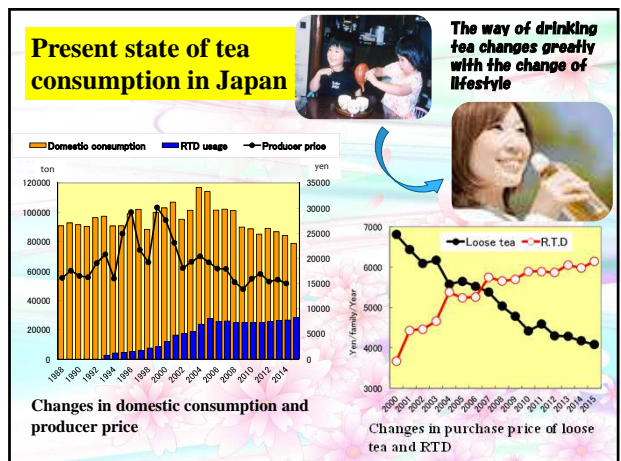
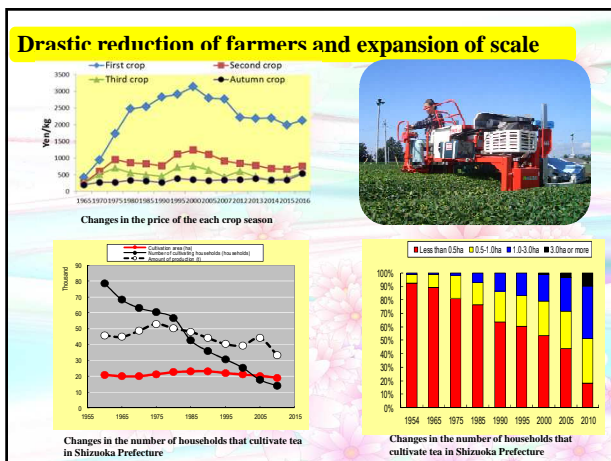
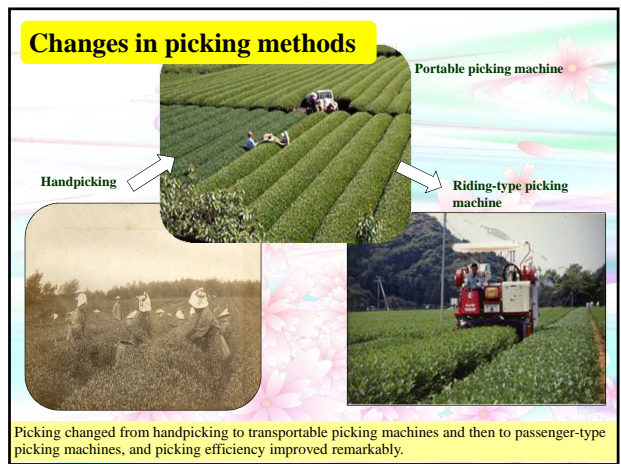
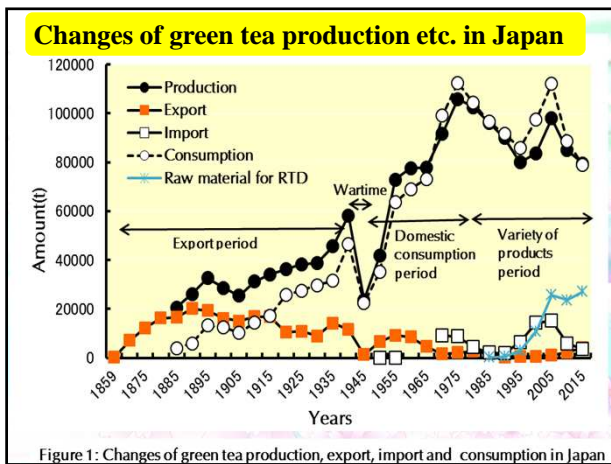
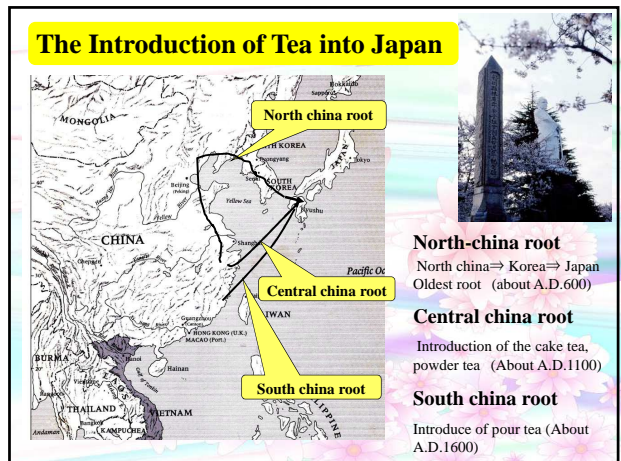
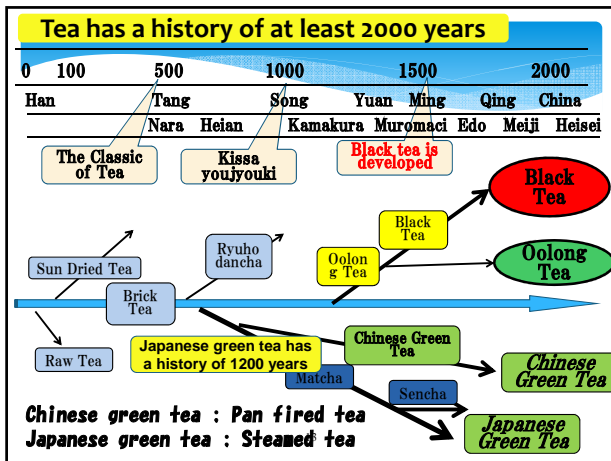
Field in Snow

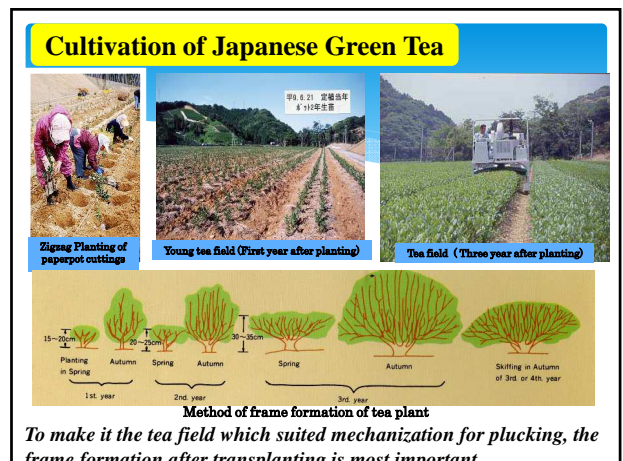
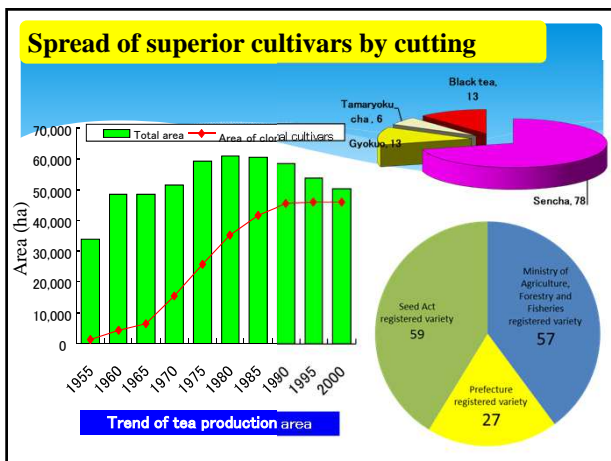
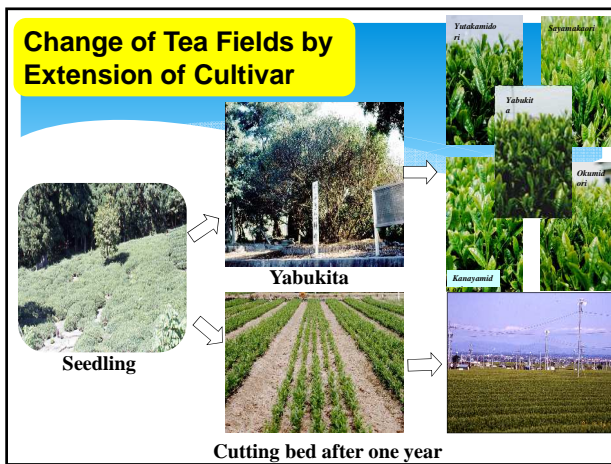
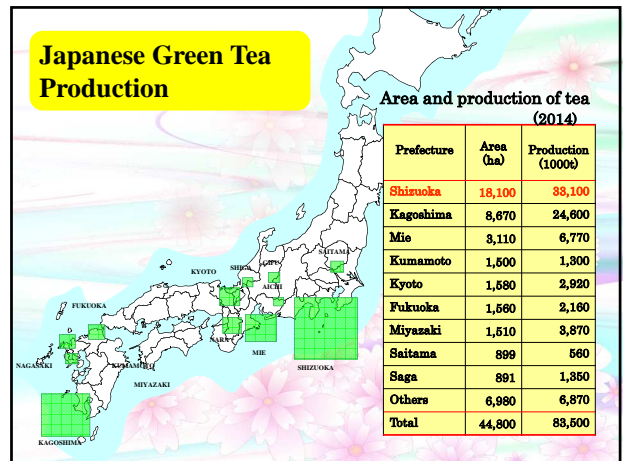
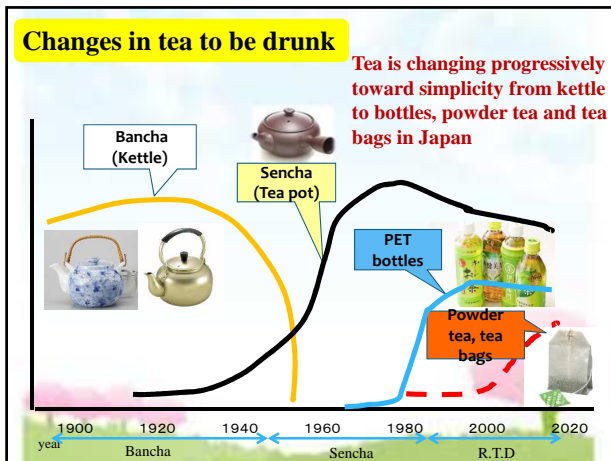
Field for Riding-type Machine

Severe Shading Field

Light Shading Field



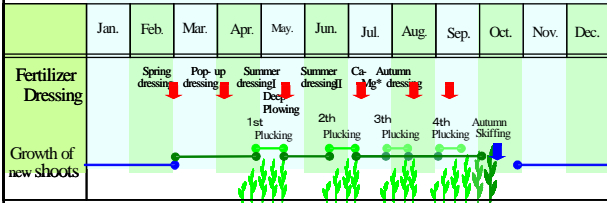




## Cultivation of Japanese Green Tea



Time of fertilizer application in Shizuoka Prefecture



## Plucking Methods of New Shoots

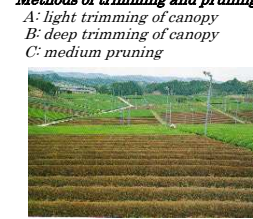
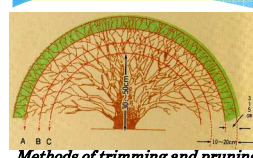
Plucking efficiency	
Methods	The amount of new shoots per day per person
Hand plucking	10 ~ 15 kg
Hand-shear plucking	100 ~ 200
Mechanical plucking	
Portable machine for two persons	700 ~ 1,000
Riding machine	4,000 ~ 5,000
Self-rail-tracking machine	2,000 ~ 3,000



## Rail-tracking and riding-type plucking machine



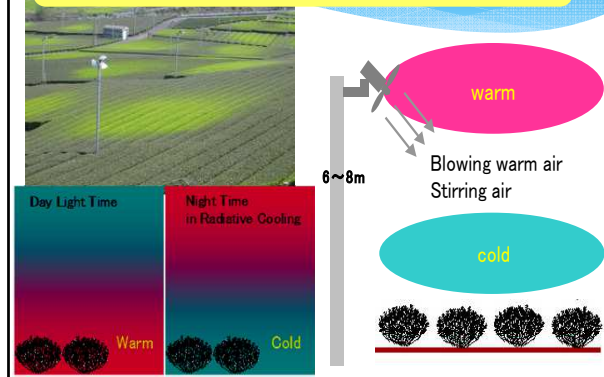
## Methods of Trimming and Pruning



## Frost Protection



## The Principle of Air Stirring Method (Anti-frost fan)



### Covering Culture in Shizuoka

19

Ceiling-shelf covering



Simple tunnel covering



<Aim>

1. to protect the new shoots against frost
2. to prolong the plucking time
3. to produce high-grade tea

Direct covering



### Culture of Gyokuro or Tencha

Gyokuro



Tencha





Matcha

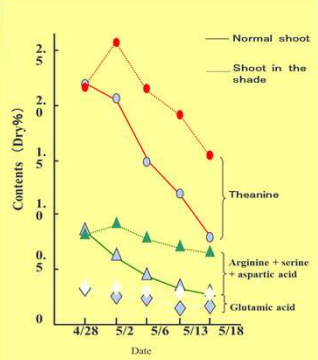


to produce high-grade tea, Gyokuro and Tencha, which are known as the finest tea in Japan, is made from the leaves grown under the ceiling-shelf covering.



### Umami increases by Covering Culture




Date	Normal shoot	Shoot in the shade
4/28	~1.8	~1.8
5/2	~2.2	~1.8
5/6	~2.0	~1.5
5/13	~1.8	~1.2
5/18	~1.5	~1.0


### Fertilizer Application

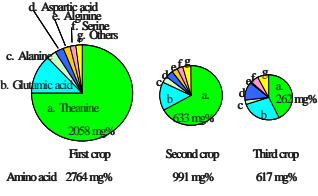
Fertilizer	Nutrients (kg per hectare)		
	Nitrogen (N)	Phosphate (P <sub>2</sub> O <sub>5</sub> )	Potassium (K <sub>2</sub> O)
Spring dressing	100	90	130
Pop-up dressing	60		
Summer dressing I	110		
Summer dressing II	110		
Autumn dressing	160	90	140
<b>Sum</b>	<b>540</b>	<b>180</b>	<b>270</b>

Deep plow subsailer



Riding-type fertilizer-plover (Fertilizer application with deep plowing)



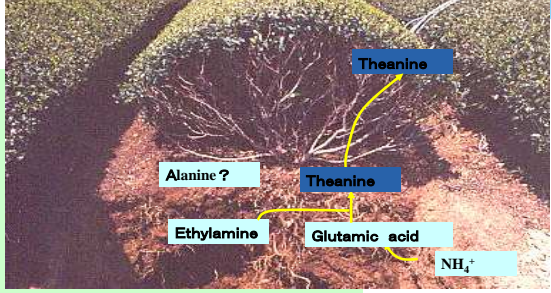


Crop	Amino acid (mg%)
First crop	2764
Second crop	991
Third crop	617

### Biosynthesis of Theanine (Umami)

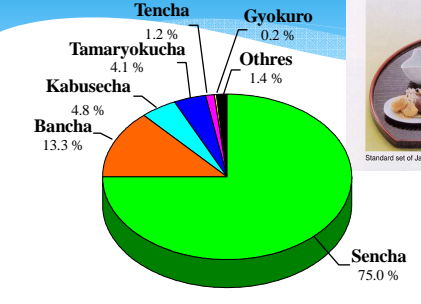
$$\text{Glutamic acid} + \text{ethylamine} + \text{ATP} \xrightleftharpoons{\text{Mg}^{2+}} \text{Theanine} + \text{ADP} + \text{Pi}$$

( $\gamma$ -L-glutamate ethylamine liase)




Theanine is composed in the root, and shifts to a new shoot.

### Production of Various Kinds of Japanese Green Tea



Tea Type	Percentage
Sencha	75.0 %
Bancha	13.3 %
Kabusecha	4.8 %
Tamaryokucha	4.1 %
Tencha	1.2 %
Othres	1.4 %
Gyokuro	0.2 %

Production of various kinds of tea in Japan



### Japanese green tea is a sharp tea like a needle

Needle type tea can only be done by steaming

### Different Kinds of Japanese Green Tea

**Sencha**  
This is the most popular type of tea in Japan.

**Gyokuro**  
This is the finest tea in Japan, and its taste is a tender sweet astringency and special flavor.

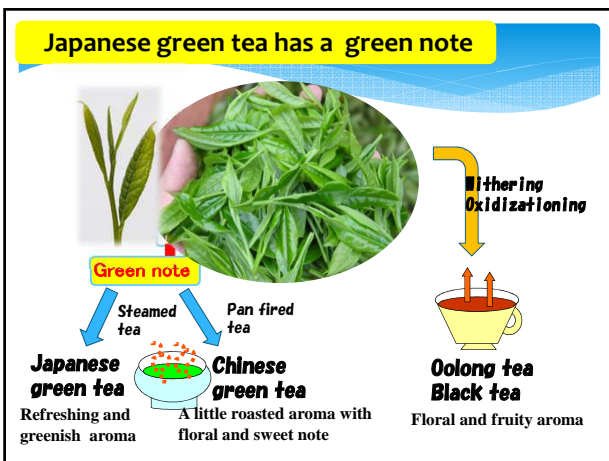
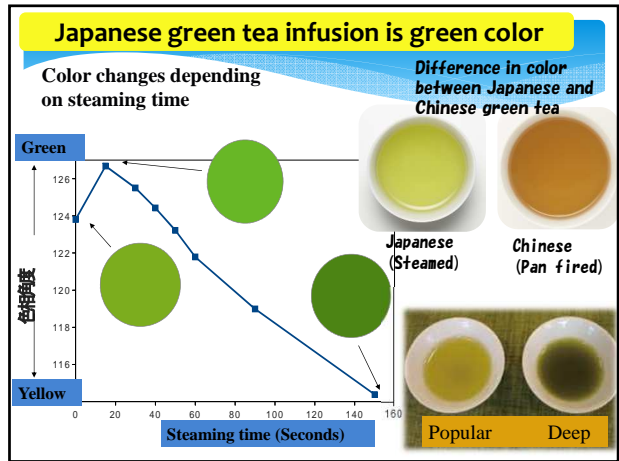
**Tencha**  
This is ground in a stone mortar into Matcha (Powdered Tea) and used in a tea ceremony.

### Different Kinds of Japanese Green Tea

**Bancha**  
This is lower grade of tea, made from mature leaves and stalks.

**Hojicha**  
This is lower grade tea, made from Bancha by roasting at about 200°C for a few minutes.


**Genmaicha**  
This is Bancha, in which poprice and Genmai are added, having good flavor.




### Characteristics of Tea

Tea have different chemical components from other plants

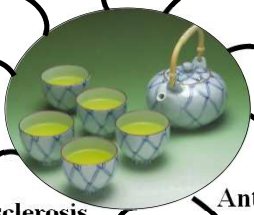
- ☆ **Caffeine**
- ☆ **Catechins of Gallate type**
- ☆ **Theanine (Free Amino Acid)**
- ☆ **Others(Fluorine, Aluminum etc.)**



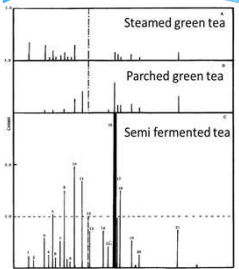
### A research on the functionality of green tea is initiated from Japan



Anti-cancer, Anti-obesity, Anti-allergic, Anti-inflammation, Anti-hepatotoxic, Others, Anti-arteriosclerosis, Anti-aging, Anti-diabetic



### Characteristics of Japanese Green Tea



Vitamin C (mg/100g)

Gyokuro	~100
Matcha	~150
Sencha	~250
Oolong tea	~10
Black tea	~5

- Color of poured tea is green
- Components are quickly eluted for steam method tea
- Amino acid content is high, catechin small amount of high amino acid content
- Aroma have freshly grassy flavor
- Shape is needle-like with firmly twist
- The content of vitamin C is high
- Japanese green tea has a long history and high cultural aspect

Fig.4. Gaschromatograms of steamed green tea, parched green tea and semifermented tea made from fresh leaves plucked on the same day. (Tadakazu TAKEO etc, 1985)

### The soluble rate of chemical component is different on different water temp.


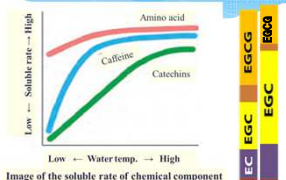



Image of the soluble rate of chemical component on different water temp.

#### The major component and the taste of tea

Amino Acids	Theanine	Sweet, Umami
	Gultamic acid	Umami acidity
	Epicatechin	Bitter
Chtechins	Epigallocatechin	Bitter
	Epicatechin gallate	Astringent, Bitter
	Epigallo catechin gallate	Astringent, Bitter
Caffeine		Bitter

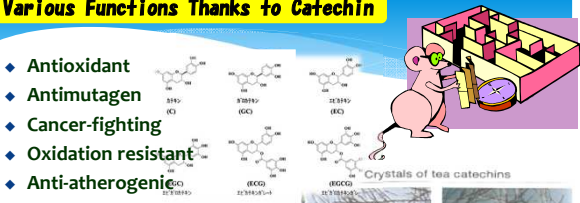
**The soluble rate of Catechins**

H, High water temp. L, Low water temp.

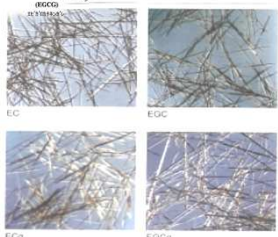
### Physiological functions of green tea components

Green Tea Components	Contents	Functions
<b>Catechins</b>	10~18%	Anti-oxidative, radioprotective, Anti-mutagenic, Anti-tumor, Enzyme inhibitory, Anti-hypercholesterolemic, Anti-hyperglycemic, Fat reducing, Anti-hypertensive, Anti-ulcer, Anti-bacterial etc.
<b>Caffeine</b>	3~4%	Removal of fatigue, Sleepy feeling, Diuretic etc.
<b>Vitamin C</b>	150~250mg%	Removal of stress, Gold prevention
<b>Vitamin B</b>	1.4mg%	Excitometabolic action of carbohydrates and amino acids
<b>Vitamin E</b>	25~70mg%	Anti oxidative, Aging prevention
<b>γ amino butyric acid</b>	0.1~0.2%	Anti hypertensive
<b>Flavonoids</b>	0.6~0.7%	Halitosis prevention
<b>Theanine</b>	0.6~2%	Anti hypertensive

### Various Functions Thanks to Catechin

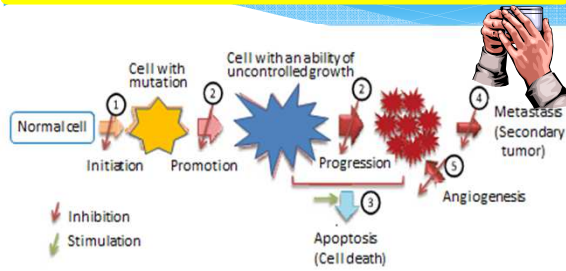


- ◆ Antioxidant
- ◆ Antimutagen
- ◆ Cancer-fighting
- ◆ Oxidation resistant
- ◆ Anti-atherogenic
- ◆ Lowers blood cholesterol
- ◆ Lowers fat absorption
- ◆ Antibacterial, antiviral
- ◆ Prevents cavities
- ◆ Improves intestinal flora
- ◆ Eliminates odors
- ◆ Controls blood pressure
- ◆ Etc. Etc. Etc.





## Cancer development and actions of tea catechins



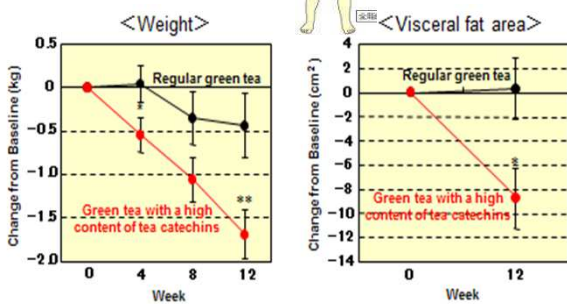
Cancer progresses through several stages as it develops including initiation, promotion, progression, and metastasis. Green tea catechins have been shown to exert anti-cancer effects at each of these stages.

## Epidemiological studies on correlation between green tea intake and the risk of human cancer

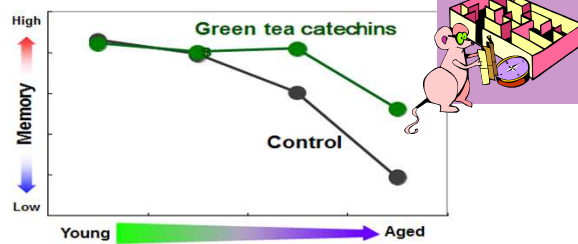
Study type	Cohort		Case-control	
	Risk reduction	No risk reduction	Risk reduction	No risk reduction
Colon	3	6	4	3
Lung	0	4	2	3
Stomach	2	6	8	8
Oesophagus	0	2	4	5
Breast	3	5	3	0
Prostate	2	0	2	0
Ovaries	1	0	2	0
Pancreas	0	2	2	1
Kidney and bladder	0	1	1	4
liver	1	0	0	0
Endometrium	0	0	2	1
Thyroid	1	1	0	0
Blood	1	0	0	0

**Cohort study:** a group of similar individuals who differ with respect to certain factors under study to determine how these factors affect the rates of a certain outcome.  
**Case-control study:** two existing groups differing in outcome are identified and compared on the basis of some supposed causal attribute.

## Effects of catechins on weight and visceral fat area



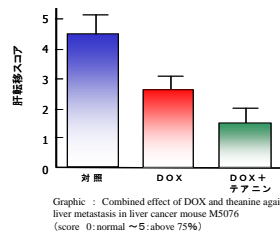
## Memory retention in mice ingested catechin



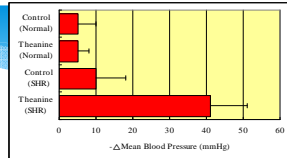
Senescence-accelerated mouse (SAMP10) shows memory decline with aging. As mice prefer a dark place, mice move into the dark box when placed in the light box. However, when mouse was given a weak electric shock through the floor of the dark box, mouse learned not to enter the dark room. Memory retention was tested one month later using same test. Memory decline was much suppressed in mice ingested green tea catechins than in control mice that ingested water.

## Functionalities of theanine

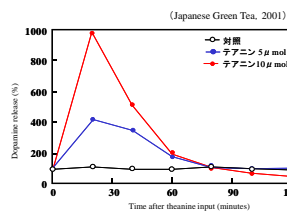
- Reduces blood pressure
- Regulates cranial nerves performance
- Prevents vascular dementia
- Strengthens anti-tumor agents
- Improves cell infiltration resistance from lung cancer



Graphic : Combined effect of DOX and theanine against liver metastasis in liver cancer mouse M5076 (score 0: normal ~5: above 75%)

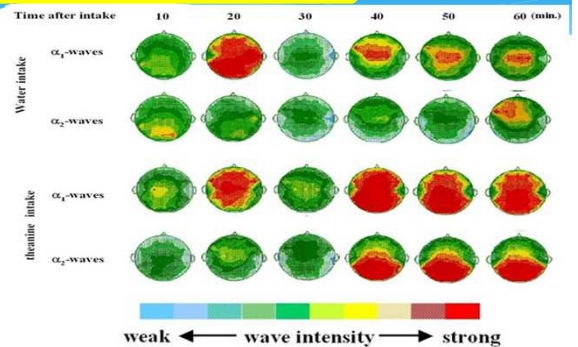


Effect of theanine on mean blood pressure in normal and spontaneous hypertensive rats (SHR).  
 H. Yokogoshi, et al. *Bioact. Biotechnol. Biochem.* 50, 615-618 (1995)

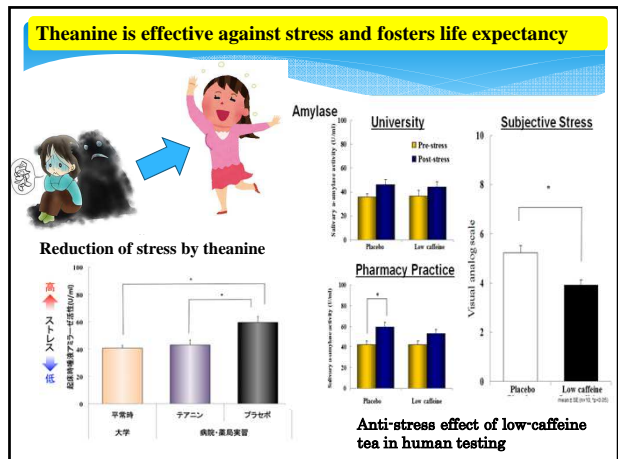
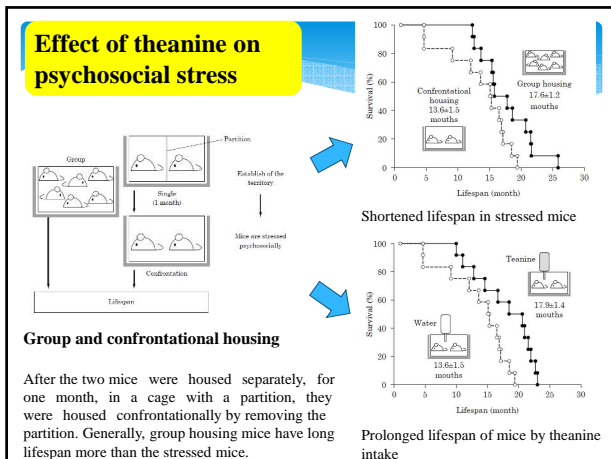


Graphic : Increase in dopamine release resulting from administering dopamine agonists in the presence of theanine.

## Effect of theanine on relaxation



Electroencephalographic measurement of alpha waves shows higher frequencies among human subjects taking theanine as compared to those taking water.



### The Japanese system of Food for Specified Health Uses and Foods with Function Claims

Foods in General	Any food labeled as a nutritional supplement, a health support, or a nutrient controlling food falls under the category
Foods with Health Claims	<b>Foods for Specified Health Uses</b> (individual approval system) Nutrient contents labelling, Health claims labelling.
	<b>Food with Nutrient Function Claims</b> (standard regulation system) Nutrient contents labelling, Nutrient claims labelling
	<b>Foods with Function Claims</b> (individual approval system) Function claims labelling
Drug	(including quasi-drugs)



### The example of goods which focused on functionality

Classification	Fields	Goods
New Type of Tea	Utilization as tea	GABA tea, Mixed tea, Low caffeine tea, etc
	New form of tea	Packed tea, Tea bag, Matcha, Instant tea, Gard type tea, Tea powder, Tea capsule, Tea tablet
	Beverage	Can drink, Bottle, Tetra pack, Tea wine, Sport drink
Dietary Field	Use for food	Tea noodle, Tea candy, Tea gum, Tea cake, Tea chocolate, Tea jelly, Tea icecream, etc
	Food material	Tea flavor, Tea paste, Tea essence, powdered tea
Daily Life Implement Field	Supplement	Catechin tablet, Water soluble catechin, Theanine tablet
	For Clothing use	Shirt, Towel, Socks, Handkerchief, Mask, Pillow etc
	For Medical use	Catechin shirt, Catechin cover, Catechin mask
	For Make-up use	Foundation, Cream, Catechin soap, Skincream, Shampoo, Bath salt, Deodorant agent etc
	Daily necessity	Note, paper, Tissue paper, Toilet paper, Slipper
Others	Wax, Filter, Pet food, Pure tea polyphenol compounds	

**Establishment of tea ceremony  
“Chanoyu / Sado”**

**Peace of the world  
from one bowl**

*The Book of Tea*  
Kakuzo Okakura

Chanoyu is often called a multiple art. Exquisite traditional arts and craft such as tea bowls, hanging scrolls, flowers, tea room and garden are all essential parts of the ceremony

**Spirits of “Chanoyu / Sado”**

In chanoyu, through exchanges of hospitality and appreciation, the host and guests can share a quite, heartwarming, peaceful time and reach a state of spiritual enlightenment so called Wa-Kei-Sei-Jyaku.

**Wa-Kei-Sei-Jyaku (和敬清寂)**  
 “Wa” : open each other’s heart.  
 “Kei” : respect each other.  
 “Sei” : purify your surrounding and your spirit.  
 “Jyaku” : maintain a spirit of quietness

**Please enjoy the classic of Japanese Green Tea**

Thank you for your kind attention