

CHAPTER THREE

SOY OLIGOSACCHARIDE, THE SOURCE OF VITALITY FOR BIFIDOBACTERIA

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THE SOYBEANS WITH FINE EFFICACY

Protein is not only one of the elements constituting our body, but also an indispensable nutrient needed by us. The protein comprised in our body is said to be about 8 to 10 kg, 70 g of which is decomposed and discharged out of the body each day. That discharged part is what must be supplemented through absorption daily. Once the protein in foods is decomposed into amino acid and peptide, they will be absorbed and transmitted through blood to all the parts of the body, and recompose, in the cells, the protein essential for the body.

The protein essential for the body is composed, in different forms, of over 20 kinds of amino acids. Among them are 8 kinds of amino acids that are unable to be composed in the body and must be absorbed from foods. They are thus named essential amino acids .

Foods rich in protein include animal foods such as meat, fish, egg, milk, etc, and plant foods such as soybean, millet, flour and so on. Compared with animal foods, plant foods contain less essential amino acids, therefore with lower nutritive value. Soybeans contain lysine that other plant products do not have and are therefore reputed to be the "meat from the fields" because the fine nutrition they contain is good for the body.

In addition, soybeans contain other nutrients of various kinds. The following is a brief introduction to the roles of the major nutrients.



The soybeans with fine efficacy, reputed to be the "meat from the fields", contain fine nutrition good for the body

PREVENTING ARTERIOSCLEROSIS

Beef, pork and other animal foods contain plenty of fat and most of the fat contains saturated fatty acid that may induce arteriosclerosis. The harmfulness of absorbing too much of it has become well known to the ordinary people.

On the contrary, soybeans contain much linoleic acid, the unsaturated fatty acid, which may reduce cholesterol, therefore being able to prevent arteriosclerosis. The soybean protein may also act on the liver, preventing it from absorbing cholesterol. This has been proved by the latest researches.

< Essential amino acids >	
isoleucine	phenylalanine
leucine	threonine
lysine	tryptophan
methionine	valine

THE DIETARY FIBERS WITH THE ROLE OF PREVENTING CONSTIPATION

Known as the sixth nutrient, the dietary fibers have roused people's universal attention. With our diet becoming increasingly fine, the amount of food intake is gradually reducing. The dietary fibers may increase the discharging amount of feces, and, therefore, stimulate the walls of the intestines and accelerate bowel movements. As the time for the feces to pass through the intestines is shortened,

carcinogens can hardly be formed in the intestines, thus preventing cancer of the large intestine. In addition, the dietary fibers also have the role of absorbing and discharging extra cholesterol, and increasing bifidobacteria in the intestines.

CONTAINING RICH VITAMINS AND MINERAL ELEMENTS

The vitamins soybeans contain include vitamin B1 indispensable for glycometabolism, vitamin B2 helpful for stimulating growth, and vitamin E useful for resisting oxidization and preventing ageing.

The mineral elements in soybeans include calcium the Japanese now lack to meet their physiological requirement, and iron and magnesium indispensable for the prevention of anemia.

USED IN LIVER MEDICINES

EPL, the medicine used for treating fatty liver is made from the phosphatide contained in soybeans. As the soybean phosphatide effectively performs the function of the yeast lipase in decomposing neutral fat; therefore it has the role of improving the conditions of fatty liver in which fat is stored in large quantities. The fatty liver mostly appears in fat people. If it is ignored, it may turn into liver diseases.

A SHINING STAR ON THE CONTEMPORARY HEALTH CARE STAGE

With the progress of society, the soybean's role in health and nutrition has increasingly roused the people's attention with the progress of society.

With the increase in economic income, people's diet is getting richer and varied daily, with most people having a partiality for animal foods. This phenomenon is now being recognized anew. Afterthoughts are occurring not only in Japan. We can find this response either in the United States or in Europe from their craze for bean-curd and steak.

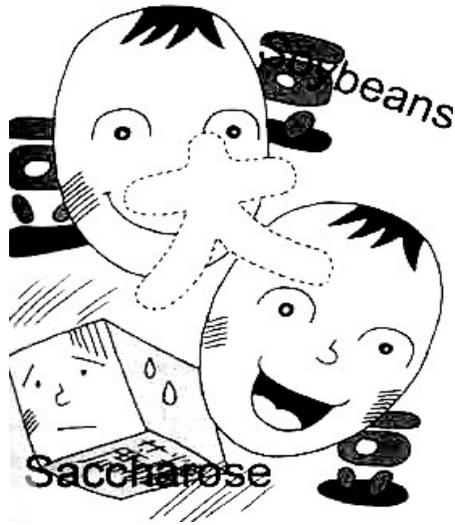
Compared with the soybean's various roles described above, the oligosaccharide, with its role in increasing bifidobacteria, attracts more attention from people. Its effect in this respect is several times that of the dietary fibers. Its special role in increasing bifidobacteria rather than harmful bacteria has made it a shining star on the contemporary health care stage all of a sudden.

ABOUT THE SOY OLIGOSACCHARIDE

The name "soy oligosaccharide" has often appeared in the newspapers and health magazines recently. As described in Chapter one, it arouses people's notice because it has become the food of bifidobacteria. Hereunder is some detailed introduction to it.

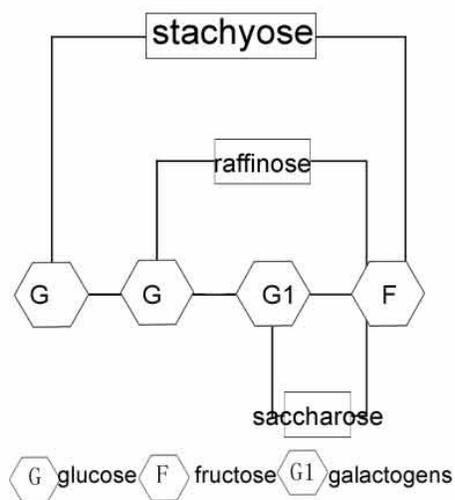
Soy oligosaccharide is the joint name of soluble sugars contained in soybeans, or in brief, one kind of sweet substances. Its main composition includes saccharose, and stachyose and raffinose that are called low-sugar gala-oligosaccharide. The gala-oligosaccharide, composed mainly of stachyose and raffinose, is the oligosaccharide that is difficult to be absorbed by the body and therefore may become the food of the bifidobacteria in the intestines. The oligosaccharide's major character lies in its choices. It is unable to become the food of the colibacilli and perfringens that are harmful to our body.

It can be seen from the morpnic structure of stachyose and raffinose that one to two galactogens are linked to the saccharose. Plenty of stachyose and raffinose are contained in beans. Soybeans contain 4% of stachyose and 1% of raffinose. The oligosaccharide extracted from soybeans contains 22 % to 30% of stachyose and raffinose, with the rest being saccharose, which is extracted together with the former part. The combination of the two parts makes the soy oligosaccharide contain 70% of the sweetness of saccharose, and have fairly strong acid and heat resisting ability. Therefore, soy oligosaccharide is a promising new type of sweetmeats, which can increase bifidobacteria, and replace saccharose as well.



Soy oligosaccharide is a promising new type of sweetmeats, which can increase bifidobacteria and replace saccharose as well.

The chemical structural formula of soy oligosaccharide



Oligosaccharide Contents in Beans (dried, %)

	stachyose	raffinose	saccharose	remarks
Peanut	0.9	0.3	5.9	Data 1
Broad bean	1.0	0.7	1.5	
Pea	2.2	0.9	2.0	
Red bean	3.8	0.3	0.6	
Mung bean	1.7	0.5	0.9	
Green bean	2.5	1.2	1.6	
Cowpea	3.5	0.5	2.0	
Sword bean	1.3	1.3	2.5	
Soybean	2.7	1.3	4.2	
Soybean	3.8	1.1	5.0	

Oligosaccharide Contents in Processed Soybean Products(%)

	stachyose	raffinose	saccharose
Parched soybean flour	5.9	1.1	3.4
Boiled soybean	0.5	1.0	7.1
Fermented bean curd	0.4	0.1	0.7
Rectified bean curd	0.4	0.2	0.5
Bean curd	0.3	0.1	0.5
Fresh bean pod	0.0	0.1	4.2

THE SEVEN MAJOR CHARACTERISTICS OF SOY OLIGOSACCHARIDE

1. Raising the multiplication speed of bifidobacteria by 4,000%

As indicated by certain tests, if an adult takes 10 g of soy oligosaccharide daily, one week later, the bifidobacteria in one gram of feces will increase by 20%, and three weeks later, the toxic fermented substances and harmful bacteria will drop by 44.6% and 40.9 respectively.

2. Increasing immunity and regulating ability

Bifidobacteria can decompose carcinogenic amine nitrite. Bifidobacteria and their metabolic products can activate the NK cells and stimulate the production of immunoglobulin antibodies by inducing the production of interferon and mitogen. The role of the macrophage is, therefore, activated and the immunity in the body increased, thus raising the body's cancer-resistant ability.

3. Reducing cholesterol

Body tests have proved that if 5 to 10 g of soy oligosaccharide is taken daily for 2 to 3 months, the total cholesterol content in serum may be reduced by 20% to 50%.

4. Protecting the liver

As shown by a test, a cirrhosis-stricken patient of 69 years old took 3 g of soy

oligosaccharide daily, and 5 days later, both of his hepatic coma and constipation were eased.

5.Reducing blood pressure

46 hyperlipemia patients took 3 g of soy oligosaccharide daily, as a result of which their average heart diastolic pressure dropped by 799.8Pa, and their blood-glucose value on an empty stomach decreased as well though not remarkably.

6.Low energy or no energy

Soy oligosaccharide can hardly be or not be digested and absorbed by the body. With very low energy or without any energy, it can be used in the low-energy foods, meeting, to the maximum limit, the demands of those people who like sweetmeats, but worry about gaining weight. It can also be used as the sweetener for patients stricken with diabetes, pimelosis and hypoglycemosis

7.Causing no dental caries

Dental caries is usually caused by the invasion of the bacteria in the mouth cavity, with the mutstreptococci in particular. As oligosaccharide is not the proper food for these bacteria, it will not induce dental cariogenesis.

THE MULTIPLICATION FACTOR OF BIFIDOBACTERIA

As the multiplication factor of bifidobacteria, to what extent can the soy oligosaccharide help to increase the multiplication of bifidobacteria? Let's see how it works through our test.

This is a test of culturing intestinal bacteria to look into their state of growth. The soy oligosaccharide was refined to contain stachyose and raffinose only. The refined soy oligosaccharide could be fully used by all the bifidobacteria, and part of the most superior bacteroides in the intestines as well, though very little compared with the bifidobacteria. (For details please refer to the table below)



The refined soy oligosaccharide could be fully used by all the bifidobacteria and part of the most superior bacteroides in the intestines as well.

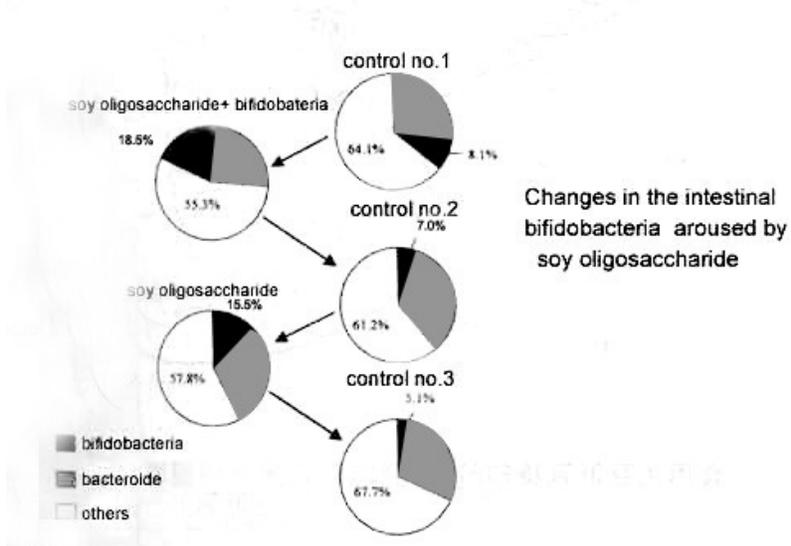
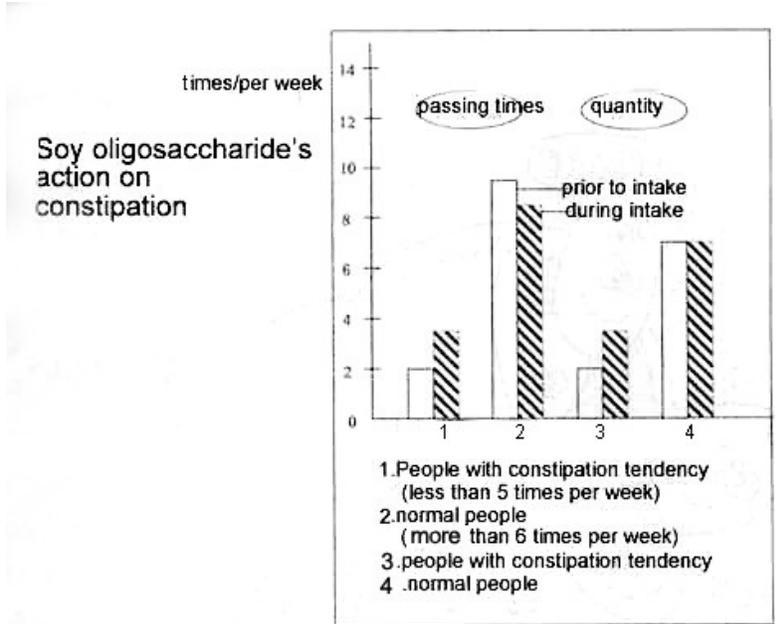
Soy Oligosaccharide – related Variations in the Multiplication of Intestinal Bacteria

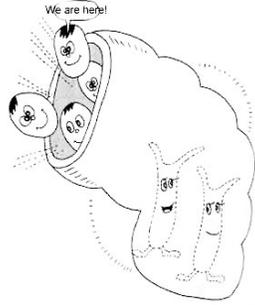
bacteria in intestines	refined oligosaccharide	soy raffinose	stachyose
Bifidobacterium			
B. bifidum	—	—	+ -
B. longum	+++	++	+++
B. breve	+++	+++	+++
B. infantis	+++	+++	+++
B. adolescentis	++	++	++
Lactobacillus			
Lactobacillus acidophilus	+ -	+ -	+ -
Lactobacillus salivarius	++	++	++
Lactobacillus casei	—	—	—
Bacteroides			
Bacteroides fragilis	+	+	+
Bacteroides vulgatus	+ -	+ -	+
Bacteroides thetaiotaomicron	-	+ -	+ -
others	-	-	+ -
Clostridium			
Clostridium welchii	-	-	-
Clostridium difficile	-	-	-
Clostridium botulinum	+	+	+
others	-	-	+ -
Eubacterium	+ -	+ -	+ -
Propionibacterium acnes	-	+ -	-
Peptostreptococcus	-	-	-
Peptococcus	+ -	+ -	+
Enterococcus	-	-	-
Colibacilli	-	-	-

Composition: soy oligosaccharide (that is, raffinose + stachyose) treated with activated carbon to remove impurities from raffinose and stachyose. The extent of assimilation: Absorbance of 630nm [(absorbance of 630nm measured after adding various sugars and culturing for 48 hours under the temperature of 37 degrees Celsius) --- (absorbance prior to culturing)]
- no multiplication +- multiplication in small quantities
+ multiplication ++ multiplication in large quantities
+++ multiplication in very large quantities

We made an investigation as to what may happen to the intestinal bifidobacteria while soy oligosaccharide is taken. 6 male adults were chosen for the test. 10 g of soy oligosaccharide and (6×10^9) frozen-dried bifidobacteria were eaten in two portions with meals each day for 3 weeks and as of the fourth week only 10 g of soy oligosaccharide was taken. The changes in the intestinal bifidobacteria were investigated with the result shown in the following chart. While soy oligosaccharide and bifidobacteria were both taken, the percentage of the bifidobacteria in the intestinal florae increased by 130%. In the case that only soy oligosaccharide was taken, the percentage increased by 120%. At the same time, the harmful bacteroides decreased remarkably. Since soy oligosaccharide is so helpful even to healthy adults in increasing bifidobacteria, it is of course much more effective to the old who think themselves short of bifidobacteria and those suffering from habitual constipation.

As a matter of fact, if 5 g of soy oligosaccharide is taken daily for one to two weeks in succession, the stool passing times may increase from 1.5 to 4 each week. There are already reports to this effect.





While soy oligosaccharide was taken, the harmful intestinal bacteria decreased remarkably.

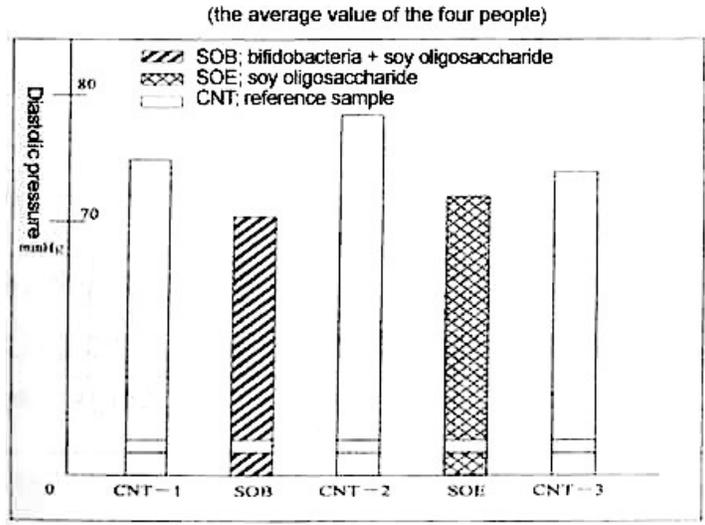
REDUCING TOXIC SUBSTANCES

While investigating the changes in the intestinal florae of the people taking soy oligosaccharide, the changes of the toxic substances in the intestines were also investigated.

In two of the six people, the septic substances were found with a dropping tendency. A comparison between the bifidobacteria and the indole in all the six people showed an inverse relationship, that is, the toxic substance indole decreased while the bifidobacteria were on the increase. It was also verified that the blood pressure of the four people with increased bifidobacteria had the declining tendency. In addition, there were reports that the carcinogens-producing enzyme and ammonia in the intestines might decrease with the increase of the bifidobacteria (for details refer to the following chart).

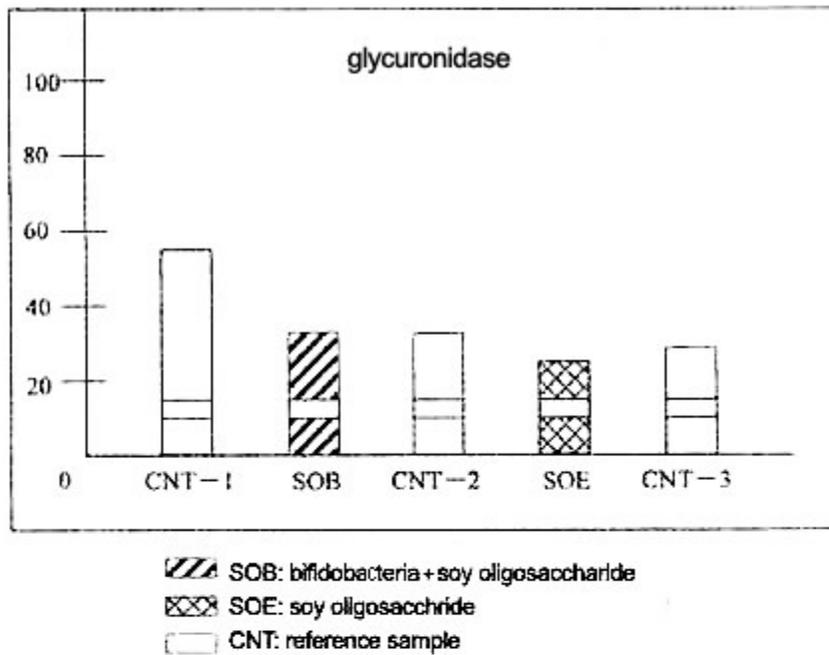
As shown in these results, soy oligosaccharide, when used as the food of bifidobacteria, may increase the quantity of bifidobacteria, therefore inhibiting and weakening the enzyme's role of producing toxic substances in the intestines.

Changes in the Diastolic Pressure Aroused by the Intake of Soy Oligosaccharide

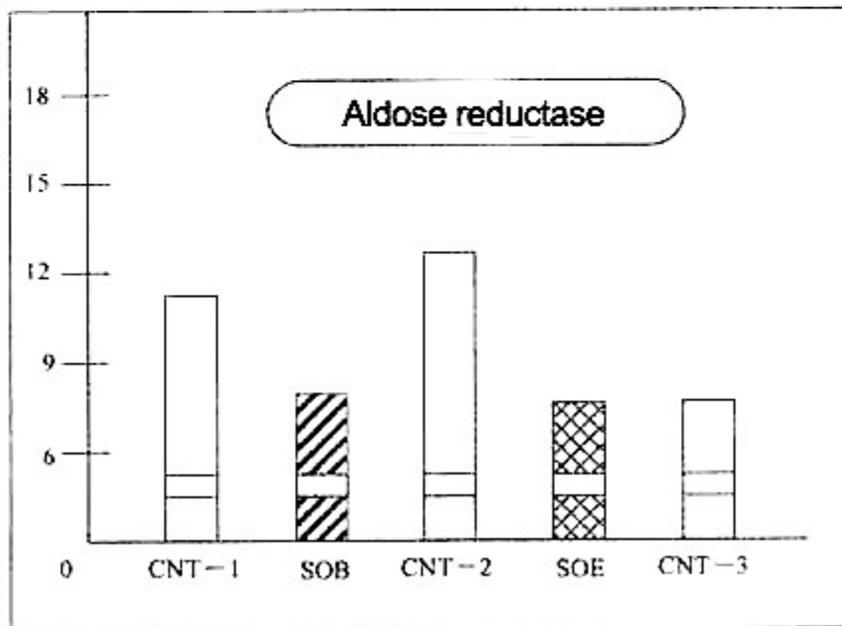


**Changes in the Toxic Enzyme in Intestines
Aroused by Soy Oligosaccharide**

µg of enzyme averagely produced from 1 mg of protein in 1 hr.



µg of enzyme averagely produced from 1 mg of protein in 1 hr.



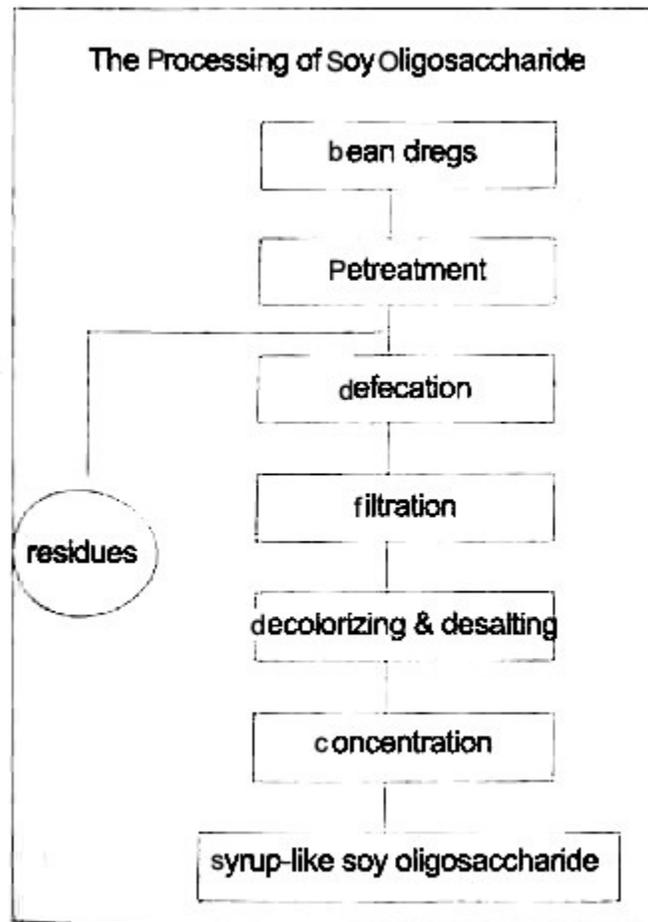
THE PROCESSING OF SOY OLIGOSACCHARIDE

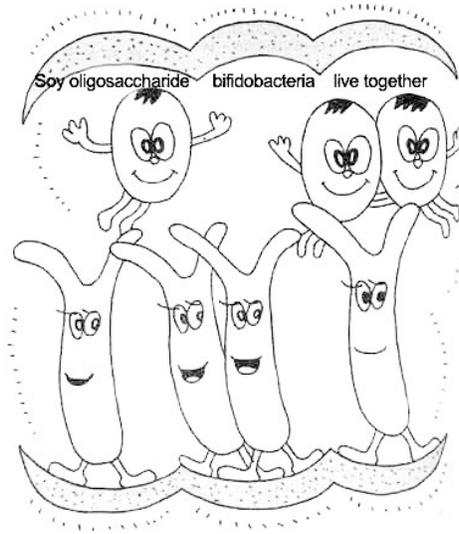
Animal foods, as a source of protein, are very important, but should not be taken too much as there are in the animal foods large quantities of saturated fat and

cholesterol, which may induce the "rich man's diseases ". Recently, soybean protein, as a changed source of protein, has attracted people's attention again.

Soybean protein is the protein after the oil is extracted from the soybeans. A lot of foods such as hamburgers processed with soybean protein can be found on the markets.

The soy oligosaccharide takes as its raw material the bean dregs after extracting protein from the soybeans. The bean dregs are first diluted, and then filtered while being heated, after which the remaining protein is removed. The material thus processed is finally decolorized and concentrated into syrup-like soy oligosaccharide.





The increase in soy oligosaccharide and bifidobacteria improves the environment inside the intestines

USING SOY OLIGOSACCHARIDE TO CHECK THE "RICH MAN'S DISEASES"

In recent years, great changes have taken place in the diet of the Japanese, shifting from eating fish and vegetables to taking meat as their main food, or from cooking raw materials themselves to extensively using the convenience foods. This diet style has made contributions to the increased height of the Japanese, but meanwhile has caused the increase in the "rich man's diseases" as in America and Europe.

The cancer of the large intestine seldom found in Japan before is now increasing rapidly, which is said to be related with eating too much meat and fat.

The human body's ability of absorbing protein and fat is limited. If too much is taken in, it cannot be absorbed completely, with part of it being transmitted to the large intestine. If constipation occurs at this time, the protein and fat may stay for some time in the intestines. During this period, the protein and fat may get putrefied with the action of harmful bacteria, and further turn into harmful materials such as amines. These amines not only can drive the blood pressure high but may also change into the carcinogenic nitrite amine. In addition, also produced are ammonia, indole, acids and other materials harmful to the body.

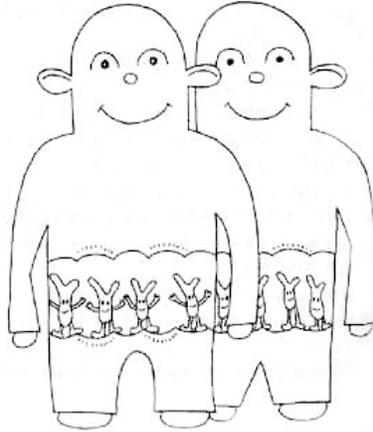
Taking these factors into consideration, we should in no way treat them lightly when our diet style is now American-Europeanized. The idea "nothing more than constipation" is very dangerous.

Keeping the intestines healthy is the key to keeping the whole body fit and preventing the "rich man's diseases".

Bifidobacteria are the guards of the intestines decomposing carcinogens and driving away harmful bacteria. It is therefore understandable for soy oligosaccharide to attract people's great attention with its role of effectively stimulating the rapid increase in bifidobacteria.

THE SAFENESS OF SOY OLIGOSACCHARIDE

If people with constipation often take purgatives, their efficiency may sometimes be reduced, and the function of the intestines weakened. However, is it safe to take soy oligosaccharide daily? It is of course understandable to raise this question.



The major role of soy oligosaccharide is to be the food of intestinal bifidobacteria and increase their quantity

Soy oligosaccharide extracted from the soybeans we eat everyday, rather than a chemical compound, has been the food familiar to us since ancient times. Its major role is to be the food of the intestinal bifidobacteria and increase their quantity. Even if it is taken more, it can only make the feces a bit softer. Nevertheless, taking much soy oligosaccharide may make some people feel full and break wind. If the soy oligosaccharide is further taken, they will, however, get accustomed to it, with their soft stools and stomach fullness gradually disappearing.

With its high safeness, soy oligosaccharide is widely used. The following is a brief introduction to its uses and prospects.

THE VARIOUS USES OF SOY OLIGOSACCHARIDE

“Health is above all” is often heard. But in reality, many people are kept on the run all day long, overlooking their health. As a result of medical progress, good medicines are unceasingly developed, which perhaps makes the people so careless about their health care.

It is this reason that puts lots of people in a state of neither illness nor good health. A slight upset may make them fall ill. This is called the “sub-healthy state”. How to resume the healthy state from the sub-healthy one and keep healthy has become an important task in the domain of the preventive medicine. The importance of strengthening the body’s physiological function and disease-resisting ability has also become the topic of conversations among people. Health foods thus come into being one after another. The soy oligosaccharide that could increase the activity of bifidobacteria emerged against this very background..

Soy oligosaccharide is characterized by being acid-resistant, heat-resistant and remaining unchanged in long-term storage. With 70% of the sweet taste of granulated sugar, it is a kind of fresh and cool sweetmeat. These characteristics are very useful in food processing, which make it extensively used in this industry. Foods

developed with soy oligosaccharide as the raw material include milk products such as children-oriented milk substitutes, yogurt, etc., fresh and cool beverages, chewing gums, hamburgers, fish cakes and so on.

VISIBLE LOW-CALORIE SWEETMEATS

Now most people are a little nervous, asking: will overeating of sugar cause any problems to health?



With the emergence of health foods came the soy oligosaccharide that could increase the activity of bifidobacteria.

For instance, when you visit somebody or a company, the host will usually serve some cakes or some local goodies brought back from their travels. Or when you have meals in a canteen, the waiter may also bring up some sweetmeats. In these cases, many people may say: "I really want to have it, but it's too sweet." They use this way to show care for their health. We believe that any woman has such similar experience.

This phenomenon indicates that lots of people are very concerned about the "rich man's diseases" such as obesity or diabetes.

Catering to this trend, certain sweetmeats have come to the fore as the substitutes for sugar.

Among the few new sweetmeats, soy oligosaccharide is especially helpful to health.

The major goal for developing new sweetmeats in the past was to make their sweetness close to that of fine granulated sugar. As tastes varied, some people considered that these new sweetmeats "didn't taste so good after having a taste of them". In the end, many of them used the ordinary granulated sugar again.

However, the sweetness of sweetmeats not only can be tasted with people's tongues but may also be indicated in figures. The analyses of soy oligosaccharide show that

its sweetness is close to that of fine granulated sugar.

With only 40% of sugar's calories, soy oligosaccharide is a kind of fairly low-energy sweetmeat. Eating soy oligosaccharide may therefore prevent the occurrence of obesity and diabetes.

THE FUNCTIONAL FOODSTUFF UNDER THE DELIBERATION OF THE MINISTRY OF WEALTH, LABOR AND WELFARE OF JAPAN

Besides nutrition and the appetite-arousing tastes, foods also contain the components that have the "organism-regulating function" for stimulating metabolism and preventing diseases. This function of the components was vaguely called "food effect" before. Now it has become one of the government's important tasks to initiatively apply the confirmed functional foods to health care on a scientific basis. The Ministry of Wealth, Labor and

Welfare of Japan is now making repeated deliberations on the formal confirmation of these "functional foods".



With only 40% of sugar's calories, soy oligosaccharide is a kind of fairly low-energy sweetmeat. Eating soy oligosaccharide may therefore prevent the occurrence of obesity and diabetes.

Soy oligosaccharide is one of the important objects under the deliberation of the ministry.

In addition to soy oligosaccharide, the following substances are also listed as the alternate objects.

1. Dietary fibers. Able to strengthen the function of the intestines, they have the role of preventing constipation and cancers, and reducing cholesterol as well. Plenty of dietary fibers can be found in barley, rye, rice and other cereals, and vegetables such as sweet potatoes, taros, potatoes, soybeans, red beans, mushrooms, edible fungi, great burdock, etc. and seaweeds.

2. Glycocalyx. Unable to be acted upon by the bacteria in the mouth cavity, it may not cause tartar, therefore having the role of preventing dental caries. It is made from cane sugar and also can be found in honey.

3. EPA. It can reduce the quantity of neutral fat and cholesterol in the blood, therefore having the role of preventing arteriosclerosis. Much of it can be found in blue-backed sardines, black carp, etc.

4. Linoleic acid. Able to reduce cholesterol, much of it is contained in soybeans and safflower seed oil.

5. CPP. It can accelerate the absorption of calcium and iron, therefore being useful for the prevention of anemia and osteoporosis. It is made from the protein in milk.

6. Lecithin. It acts in the intestines as a substance for metabolism, being able to inhibit the deposition of cholesterol and accelerate the metabolism of fat. Plenty of it is contained in soybeans and egg yolks.

In addition, γ -linolenic acid, ferroheme, B-carotene and so on are also under deliberation.