

# Japan's culinary restoration

How the science behind the *washoku* food tradition could ease the burden of an ageing society and breathe new life into an ailing agricultural sector.

BY BRETT DAVIS

There are few forces more powerful than a national crisis to spur innovation and structural change, as Japan's food industry is quickly learning. The country is facing daunting challenges — a rapidly ageing population, shrinking agricultural and fishing industries, and continuing repercussions from the 2011 Fukushima Daiichi nuclear disaster. But there have also been glimmers of hope following the recognition in 2013 of Japan's culinary tradition, *washoku*, by the United Nations Educational, Scientific and Cultural Organization as part of an initiative to safeguard local cultural values.

## AN UNCERTAIN FUTURE

A combination of the population's remarkable longevity and a low birth rate associated with Japan's decades-long economic malaise has given the country the dubious honour of having the world's most rapidly ageing population: just over one-quarter of Japan's citizens are now over 65, and this group is expected to swell to 40% by 2060.

The populations of many farming and fishing villages may have already reached this proportion. Younger generations are escaping rural Japan en masse, lured by the opportunities of city life and leaving behind not just a less-attractive career in agriculture, but also family roots and centuries-old agricultural and culinary traditions. Japan's rural sector has been left with an empty stomach.

"The agricultural decline affects not just food supply but also society," says Katsuyoshi Nishinari, former president of Japan's Society for Food Science and Technology. "Youngsters from rural areas have not been staying in their hometowns to continue the family farming business, so rural villages have been becoming smaller, shops are closing and public transport has been lost from many areas."

Compounding the situation is the increasing thrift of the Japanese consumer in the face of a generation-long decline in income. The dip has resulted in a significant shift to importing cheaper produce and an eroding interest in traditional fare in favour of a more Western diet.

The Japanese government's push to have

the country's culinary tradition recognized by UNESCO may have been a pragmatic move to dispel doubts about the country's food safety following the events in Fukushima, but it worked even better than expected. Although food consumption at home has been falling (owing to the ageing and declining population), agricultural exports have steadily increased over the past 4 years to a record high of ¥750 billion (US\$6.7 billion) in 2016. The surge results from increased international demand for *washoku* staples such as green tea, soy sauce, wagyu beef and saké. It's a turnaround that has sown the seeds of promise for Japan's agricultural sector. The public discourse on *washoku* has also increased consumer interest in quality local produce, and lit a fire under Japan's already well-developed 'functional food' industry. (Functional foods are those that have been shown to have specific physiological benefits.)

Since *washoku* was listed by UNESCO, there has been intense renewed interest about its health benefits, and how it may be responsible for Japan having the world's highest life expectancy, says Osato Miyawaki, a food science and engineering researcher at Ishikawa Prefectural University in central Japan. "The popularity of *washoku* has also exploded internationally, with the number of *washoku* restaurants increasing dramatically worldwide."

## THE FUNCTIONAL FOOD REVOLUTION

Japan has always held a keen interest in the health benefits of its traditional cuisine. Alongside rice (see 'Filling Japan's rice bowl') and raw fish, the *washoku* diet features fermented and cured foods such as natto and miso, as well as green tea, all of which have been linked to the longevity of the Japanese people.

Foods such as natto contain polysaccharide sources including mucin and fucoidan, which can reach the colon without being digested. There, they are converted into short-chain fatty acids, which might help to regulate insulin secretion, appetite, blood pressure and fat accumulation.

Green tea is a potent source of antioxidants, and there is evidence that tea consumption hinders the development of some chronic ▶

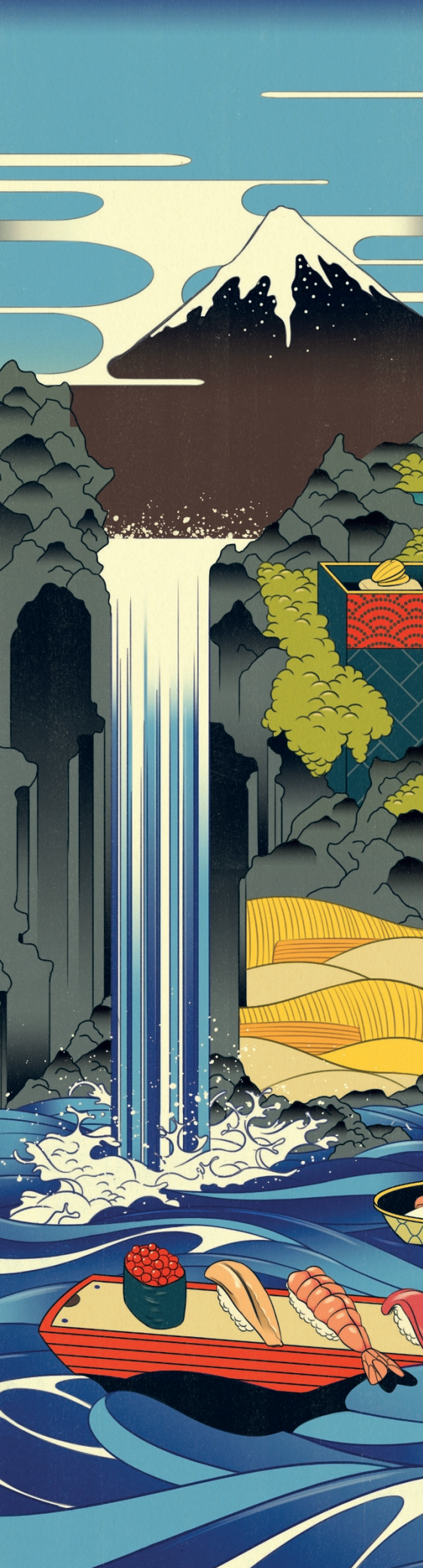




ILLUSTRATION BY ANDREW ARCHER

► diseases, including cardiovascular disease and cancer, although international studies are conflicted.

The Japanese obsession with the unique qualities of *washoku* also led to the definition of a new component of taste — umami. Championed by Japanese food scientists and recognized by the international community in the 1980s, umami, the savoury taste of glutamic acid, is a fundamental feature of Japanese food. And as scientists are now discovering, it has an important role in satiation and, in turn, in a balanced diet.

A prominent area of research on functional foods is the support of the digestive system through modification of the gut's community of bacteria. Japanese supermarkets sell dozens of probiotic yogurts and drinks each with their own proprietary strain of 'healthy' bacteria, and Japan's big dairy processors have made substantial investments in probiotics research. A healthy digestive system is being increasingly recognized as an important factor in a robust immune system, and a potent target for therapies that might help to keep people out of hospital, something of particular interest in ageing Japan.

The soya-bean oligosaccharides raffinose and stachyose are also being widely promoted by product manufacturers as 'prebiotics', which can selectively stimulate the growth and activity of health-promoting gut bacteria. Soya has become an important basis for functional foods, says Nishinari, and it is "an excellent non-animal source of protein and oligosaccharides linked to digestive health". Some of the biggest food companies are investing in developing soya cream, cheese and yogurts that have reduced odour and enhanced health benefits, he adds.

### JAPAN'S DROP IN THE OCEAN

A mainstay of *washoku* is raw fish, which is also thought to be one of the pillars of Japanese longevity. Fish is high in omega-3 fatty acids, which are being widely investigated for their role in reducing cancer risk and improving heart function. Part of the Japanese diet for more than a thousand years, it's difficult to overestimate the importance of sashimi, a raw-fish preparation, and sushi, its more modern counterpart, eaten with vinegared rice. Until the mid-1980s, the average Japanese diet consisted of more than 70 kilograms per year of seafood, much of it eaten raw. (The world's average fish consumption per person was then around 10 kilograms.) And with limited land available for grazing, fishing has long been an integral and daily part of Japanese culture.

"We have a peculiar attitude to seafood in that the consumer demands fresh wild fish," says Masanori Miyahara, president of the Japan Fisheries Research Agency. "This means we are heavily dependent on the coastal catch. But it's no secret that our coastal fisheries are dying."

The depletion of fish stocks is a global phenomenon and Japan's predicament is no exception, but not for the reasons often espoused. Although the Japanese diet is undoubtedly high in seafood, consumption has decreased over the past decade,

to less than 50 kilograms per year per person, or close to 6 million tonnes in total annually, two-thirds of which is met by imports. Over the same period, Chinese consumption has exploded, from 20 million tonnes to more than 50 million — with much of the catch occurring in the international waters shared by east Asian nations.

“We face some huge challenges. Overfishing is just one. Climate change is also altering currents and sea temperatures in critical fishery areas, particularly off northern Japan around Hokkaido,” says Miyahara. But there have been some promising advances that could help to establish a sustainable fishing industry, he adds.

One of the most exciting developments is the 2015 success of Japanese scientists in breeding and raising bluefin tuna — which is on the threatened-species list of the International Union for Conservation of Nature — in captivity for the first time, a project first conceived in 1970. Although raising mature bluefin from wild juvenile fish is well established, starting with eggs — potentially a more commercially viable process — has proved much more challenging. Tuna larvae are sensitive to temperature, currents and even noise. In previous breeding projects, less than 0.5% of larvae survived. The few remaining juvenile fish would eat or fatally collide with each other and their surroundings before reaching a harvestable age.

Over the past few years, researchers at Kindai University in Wakayama, near Osaka, have found conditions for hatching bluefin tuna that achieve a tenfold improvement in survival rates, and have introduced other

sacrificial fish species into the incubation system to lower rates of cannibalism. Kindai’s Aquaculture Research Institute is now harvesting 3-year-old, 30-kilogram bluefin, raised from eggs in captivity, for commercial sale — a world first with potentially huge implications.

“Our success with the bluefin breeding project late last year has attracted strong interest and real investment from some of the biggest companies in Japan’s fishing industry,” says Miyahara. “Given the difficulties faced by the wild-catch industry, aquaculture is critical to re-establishing a sustainable fishing industry, and for that private investment and support are vital.” He expects the bluefin project to serve as a model for future fisheries and hopes that it will drive consumer preference for sustainably farmed fish in Japan.

With the 2020 Olympic Games looming, Japan is eager to demonstrate the values of *washoku* to the world — and not just its health benefits and emphasis on quality produce, but also its sustainable ideals of food production. Keeping these traditions alive while supporting a modern economy will require some finesse, along with a healthy dose of science and innovation. Fortunately, many of the ingredients look like they are falling into place.

“Many people are talking about sustainability as we approach the Olympic Games,” says Miyahara. “We really want to have something important and profound to showcase over the course of that event — to leave a lasting impression.” ■

**Brett Davis** is a freelance writer based in Melbourne, Australia.

## FOOD TRENDS

### Filling Japan’s rice bowl

Rice has been cultivated in Japan for more than 2,300 years, and has been central to the prosperity of the nation.

“We have such a small amount of arable land, and rice as a crop offers the highest energy density per hectare while being very well suited to our climate,” says Katsuyoshi Nishinari, former president of Japan’s Society for Food Science and Technology. “Over time, the Japanese have developed a very particular preference for short-grain sticky rice, like the most popular *koshihikari* variety commonly used for sushi.”

Despite its history, the once-dominant grain is being displaced by wheat — a result of the increasing Westernization of the Japanese diet. As Japan’s rice consumption has fallen steadily from more than 13 million tonnes per year 50 years ago to less than 8 million tonnes in 2011, the Japanese tax payer has had to subsidize rice farmers to avoid a price crash and keep them on the land. The government has tried to address

this by buying up farmland or paying farmers to leave their paddies fallow, but this approach could cause its own crisis. “There is no incentive for farmers to be more productive or efficient because the government buys all their rice at an agreed price, which is passed on to the consumer,” says Nishinari, and the current situation is not sustainable. “As climate change, too, starts to influence yields and force changes to ages-old practices, we have found ourselves in very dire circumstances.”

One solution championed by the government and rice growers’ associations is to push for a resurgence in the popularity of rice. “We now see rice bread and rice noodles becoming popular,” says Osato Miyawaki, a food science and engineering researcher at Ishikawa Prefectural University in Japan. “There is a lot being done to reintroduce rice in new ways like this, but *washoku* is also playing a major role in strengthening demand.” **B.D.**

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SPRINGER NATURE

# DEVELOPING FUNCTIONAL FOODS FOR THE NEXT GENERATION

A national research program focusing on **THE HEALTH OF JAPAN'S AGEING POPULATION** is working with academia to develop new functional food research.

**"Longevity is increasing dramatically in Japan** and it is vital that we maintain good quality of life for our ageing population," says Professor Keiko Abe (sub-program director) of the Department of Applied Biological Chemistry at the University of Tokyo.

A Japanese national research and development project aimed at promoting healthy longevity in a society with ever-increasing life expectancy has been formed to address this need. 'Functional and Agricultural Food Products for the Next Generation' is a sub-program of the Japanese Cross-ministerial Strategic Innovation Promotion Program (SIP) 'Next Generation Agriculture, Forestry and Fishery Creation Technologies'. The key approach to achieving this goal is the development of functional foods — foods that deliver specific health benefits in addition to their contribution to basic nutrition.

Professor Abe notes that the term 'functional foods' was coined in Japan around 30 years ago, following research on the health benefits of

novel and traditional foods in the Japanese diet. It has since become a commonplace term used across the global food science community. In addition to 'foods for specified health uses' (FOSHU), approved since 1991, a new policy — 'foods with function claims' — has started to make us recognize the importance of basic research on food functionality.

This new project spreads its research much wider, to investigate the role of specific food components and supplements in a wide range of health concerns, including metabolic disorders, cognition, memory, psychological stress, muscle impairment and bone disease.

**IT IS  
EXTREMELY  
IMPORTANT  
TO LEARN  
MORE ABOUT  
HOW TO  
MAINTAIN  
HEALTH AS  
PEOPLE AGE**

The project is divided into four research areas: improved brain function



(cognition), locomotion, sports-related nutrition and the evaluation of homeostasis.

Many functional foods already on the market target existing health problems. Professor Abe emphasizes that the current project aims to ensure a good quality of life through people of advanced age who are still healthy. "It is extremely important to learn more about how to maintain health as people age," she says.

#### Health products

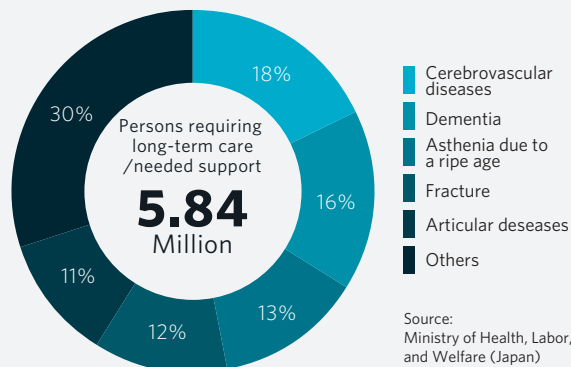
As well as promoting healthy longevity in Japan, another aim of the project, which

has annual funding of about ¥0.5 billion, is to develop commercial products for export. Potential candidates are already emerging, some of which were highlighted at a symposium at the Asahi Hall in Tokyo in 2015. Associate Professor Shoko Kobayashi of the University of Tokyo discussed animal trials and early clinical studies indicating that the natural substance rosmarinic acid may delay the onset of dementia by preventing aggregation of proteinaceous amyloid plaques in brain cells. Professor Hiroaki Masuzaki of the University of the Ryukyus revealed that



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## MAJOR MEDICAL CAUSES THAT REQUIRE CARE IN JAPAN (2013)



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## FUNCTIONAL FOOD RESEARCH

Since 2014, Functional and Agricultural Food Products for the Next Generation have been developed based on scientific evidence.



**376**  
original papers



**15**  
patents



**Around 200**  
presentations at international meetings

feeding hospital patients brown rice containing gamma-oryzanol, or rice bran oil, can significantly suppress postprandial blood sugar levels. Professor Narumi Nagai of the University of Hyogo presented research linking maslinic acid, found in olives, to improved grip strength and reduced knee pain in elderly subjects.

The possibilities for better methods to evaluate body homeostasis were exemplified by a prototype system developed by Hamamatsu Photonics. This is a simple optical sensing device that uses a small blood sample to

analyse biochemical markers of immune function and other cellular indicators of health. These few examples offer some insight into the wide range of approaches being researched across the four key areas of activity.

This consortium comprises 49 academic bodies with 186 workers on 28 research subjects. It is also supported by 46 food production companies with the aim of promoting basic investigations on physiologically functional factors contained in agricultural products. "It is important to accelerate the commercialization of academic

research through links with industry," Abe says.

Moreover, research on biological markers can be used to identify people at risk of developing diseases that could affect their quality of life as they age. "We want to use this research to develop foods that can prevent disease from emerging in people who are not yet aware that they are in danger of developing any specific condition".

Abe says the project's success will be marked by a happy elderly society with significantly improved quality of life relative to that which many

elderly people experience at present.

Given that a long-term goal is to bring new functional food products to the commercial market, the project includes strong links with many food production companies.

The program, which is coordinated by the Ministry of Agriculture, Forestry and Fisheries, began in October 2014 and will end in March 2019. ■



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# FOOD SIGNALS POINT WAY TO BETTER HEALTH

**NEW FOODS BEING DEVELOPED** as part of a major Japanese research project show potential for improving brain function.



**Takumi Misaka**  
The University  
of Tokyo

**By 2025**, more than 30 per cent of Japanese are expected to be over the age of 65, making them the oldest society in the world. A national research project is underway to support this ageing population. The five-year (2014-2018), ¥1 billion project 'Understanding food signalling for the innovative development of novel functional foods to improve brain function' is one of the sub-programs funded by Japan's cross-Ministerial Strategic Innovation Program (SIP).

**WE ARE ANALYSING HOW THE BRAIN RECOGNIZES THESE FOOD SIGNALS AND HOW THEY AFFECT PERIPHERAL ORGANS SUCH AS THE GASTRO-INTESTINAL TRACT, LIVER, PANCREAS, MUSCLES AND SKIN.**

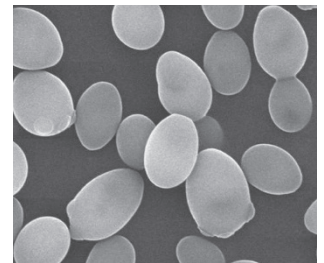
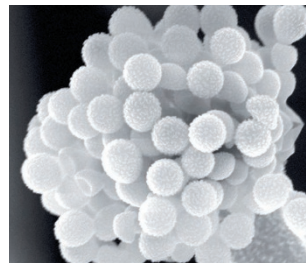
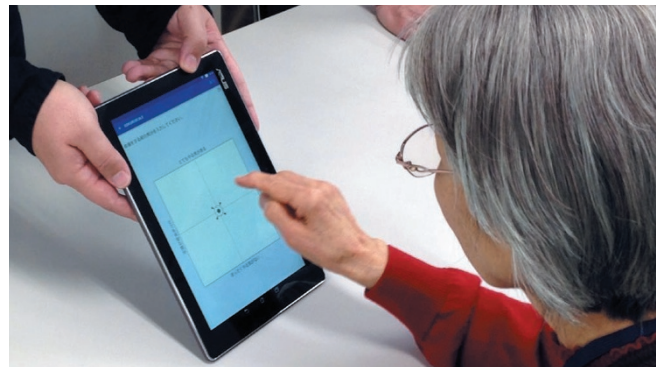
"The idea behind this research is that receptors on the

surface of the gastrointestinal tract produce signals when they interact with ingested food compounds and the digestive and/or metabolizing compounds. This food signalling induces physiological reactions," explains Associate Professor Takumi Misaka at the University of Tokyo.

"We are analysing how the brain recognizes these food signals and how they affect peripheral organs such as the gastrointestinal tract, liver, pancreas, muscles and skin." The team, comprising more than 50 researchers and 31 food companies, aims to produce at least ten 'next-generation functional foods' by the end of the project.

Of the 120 studies published so far, one, for example, has shown that extracts from maple syrup revert gene expression patterns back to normal in mice fed on high-fat diets, potentially mitigating liver inflammation. Another study found that flavan-3-ols, a group of polyphenolic substances abundant in chocolate, reduced blood pressure and enhanced thermogenesis and lipolysis, reducing weight gain from a high-fat diet.

**The role of foods in cognition**  
Shoko Kobayashi at the University of Tokyo and



Masahito Yamada at Kanazawa University Graduate School of Medical Sciences are investigating the effects of natural phenolic compounds, such as rosmarinic acid, on Alzheimer-causing brain plaques. A

transgenic mouse model fed these phenolic compounds showed significant reduction in amyloid beta-protein deposition in the brain, suggesting their potential for the prevention and treatment of Alzheimer's.

**Brown rice for diabetes**

In southern Japan, researchers are working with a food and pharmaceutical company to develop fermentation-based beverages and supplements to prevent and treat obesity-diabetes syndrome. Hiroaki Masuzaki of the University of the Ryukyus in Okinawa and colleagues are investigating brown rice, which has long been known to improve glucose tolerance and prevent the onset of diabetes.

The researchers tested the hypothesis that brown rice specifically contains several metabolically-beneficial

compounds not found in other grains.

The endoplasmic reticulum (ER) is a cellular network of tubules responsible for synthesising, folding and trafficking proteins within cells. In various diseases, 'unfolding' proteins accumulate in the ER, a condition called ER stress. These unfolding proteins are toxic to cells and induce apoptotic cell death. In recent years, studies have shown that the pathophysiology of obesity and diabetes is closely related to exaggerated ER stress in obese-diabetic mice. Notably, the fermentation-

based gamma-oryzanol-rich beverage produced by Aizu Tenpo Co.,Ltd. showed strong potential to improve the imbalance of gut microbiota in conjunction with the reduction of ER stress, says Masuzaki.

Unfortunately, the gastrointestinal tract is inefficient in its capacity to absorb gamma-oryzanol. So Masuzaki and his team, including colleagues at SENTAN Pharma Inc., encapsulated the compound in polymer poly (DL-lactide-co-glycolide) nanoparticles. They found that a single bi-weekly oral dose of 'Nano-Orz' markedly improved

glucose and lipid metabolism in obese-diabetic mice compared to regular gamma-oryzanol. It also markedly reduced ER stress in various tissues.

The team is now investigating the potential benefits of gamma-oryzanol in cognitive impairment, decreased physical activity, and addiction to alcohol, nicotine and dietary animal fats, all of which are often associated with obesity and diabetes. ■

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## Food for movement

Functional foods that could improve the locomotor system are being developed with the aim of **HELPING OLDER PEOPLE RETAIN INDEPENDENCE** while also reducing medical costs.



**Ryuichiro Sato**  
The University of Tokyo

**The locomotor system** refers to human muscular and skeletal mechanisms that control body movements. To maintain a healthy locomotor system, a proper diet and regular exercise are crucial. But, getting enough exercise is not always easy for elderly

people, which is where functional foods could help.

"A proper diet occasionally supplemented with functional foods could prevent muscle atrophy," says Ryuichiro Sato, Professor at the University of Tokyo.

Sato and Yasutomi Kamei, Professor at Kyoto Prefectural University, are leading basic research on the subject as part of a consortium on functional foods that consists of seven research groups. So far, they have found that AMP kinase



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and PGC-1 $\alpha$  genes in skeletal muscle, which are normally triggered by exercise, are associated with enhancing metabolism and muscle protein synthesis, respectively. This finding could be used to develop compounds that could mimic the effects of exercise, without the body actually doing any exercise, says Sato.

They also found that some of the genes classified as G protein coupled receptors contribute to an increase in the size of skeletal muscle, known as muscle hypertrophy. Whereas, E3 ligases — enzymes that connect a degeneration marker to proteins — accelerate muscle protein degradation.

Other projects are investigating potential natural, locomotor-enhancing compounds, for example, cod. Joint research by Taro Kishida, Professor at Ehime University and Nippon Suisan Kaisha

Ltd showed that rats fed a special diet containing 20 per cent codfish protein instead of the milk protein casein for seven days had increased muscle mass. They are now investigating the mechanisms behind the beneficial effects of this protein.

Another project led by Ken Nikawa, professor at Tokushima University, is looking at flavonoids in brown seaweed. The researchers discovered that a flavonoid called morin, found in brown seaweed, prevents muscle atrophy. This finding could also have environmental benefits as currently large amounts of seaweed are discarded as industrial waste during food processing.

Shinji Miura, Professor at the University of Shizuoka, and colleagues reported that tomatine, which is found in the skins, leaves, roots and unripened fruit of tomatoes,

increases the protein synthesis rate, leading to an increase in muscle mass, in the skeletal muscle of mice. The team is now investigating an efficient way to purify aglycon tomatine (tomatidine), that is safe and effective to use, from tomato leaves and green tomatoes.

Olives are another potential functional food source. Maslinic acid in olives and pomace (the pulp remaining after oil is extracted) is known to help control inflammation. Currently, the country's largest olive production is in Kagawa prefecture, where production increased from 66 tonnes to 383 tonnes between 2000 and 2014, but there is no effective use for the pomace. So Nippon Flour Mills Co. Ltd. has decided to use the waste material in a number of new products.

The company has developed an extraction method for maslinic acid and introduced

a product known as Olive Fruit Extract that contains 10 per cent maslinic acid and 15 per cent other olive fruit components. However, since the data for the health effects on humans are still being accumulated, these products are not yet labelled as functional foods, says Kazuhiko Aida, vice manager of Nippon Flour Mills Innovation Center.

In the near future, the company plans to develop functional foods with maslinic acid that could prevent locomotive syndrome (a condition of weakened mobility), extend healthy life expectancy while, at the same time, helping to revitalise the region's agricultural sector. ■



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# TIMING MATTERS FOR FOOD AND EXERCISE

New research indicates that **MORNING IS THE BEST TIME TO EAT AND EXERCISE**. The results could help address age related disorders by better timing of physical activity and meals.



**Shigenobu Shibata**  
Waseda University

**New research from scientists at Japan's Waseda University in Tokyo**, suggests there is an optimal time in the day for eating and exercising, indicating that 'chrono-nutrition' and 'chrono-exercise' may form a recipe for optimal health and longevity.

A team led by Shigenobu Shibata at Waseda University has examined the benefits of timing both food and exercise. Circadian clocks, which control our sleep/wake cycles, are affected by external cues including light and dark, food, stress, and exercise. Dysregulation of circadian

cycles is linked to disorders like obesity and diabetes.

Research animals' internal clocks can be shifted by restricted feeding and scheduled exercise cycles in the laboratory. Mice that received a protein-rich breakfast, compared to dinner, showed higher increases in skeletal muscle volume. Likewise, morning exercise is most beneficial. Mice released for exercise in the morning showed better muscle recovery than those released at noon or in the evening.

"Morning light is known as a strong extrinsic cue for the suprachiasmatic nucleus clock, the main oscillator in the brain [for circadian regulation]. And morning exercise and feeding are known cues for peripheral organ clocks," explains Shibata.

Research in humans indicates similar benefits

of morning feeding and exercise. An ongoing study by Yasuo Kawakami and his team comparing morning and afternoon exercise in elderly individuals suggests that morning exercise is more effective for improving locomotive functions. "This is presumably because of the adjustment of peripheral circadian clocks by morning exercise that stimulates the neuromuscular system for higher adaptability and better performance," suggests Kawakami.

Circadian cycles also influence and are affected by rhythmic gene expression. Haruko Takeyama and her team aim to supplement the convincing physiological data from Shibata and Kawakami by examining potential links between gene expression

and health. "We are focusing on biofactors/profiles in gut microbiota, miRNA profiles in blood, and saliva stress markers related to ageing," explains Takeyama.

These findings have far reaching benefits, especially for Japan's rapidly ageing population. "The goal is to provide the perfect combination of food and exercise at the most effective time of day, which will benefit middle-aged and elderly individuals, in particular, who are at risk of frailty, sarcopenia and metabolic syndromes," says Kawakami. ■



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# Measuring body balance for diet assessment

A SIMPLE, RAPID BLOOD TEST FOR EVALUATING HOMEOSTASIS by monitoring daily changes in health could help doctors treat lifestyle diseases and ageing with functional foods.



Gen-Ichiro Soma  
Control of Innate  
Immunity TRA

## The Multimodal Homeostasis Evaluation Development

**Group Consortium**, has developed a quick, effective test that detects subtle changes in the body that may lead to lifestyle related diseases.

A healthy human body exists in a carefully balanced state, with the central nervous system, hormones and innate immunity working together to maintain a stable internal condition, known as homeostasis. Disruptions in homeostasis caused by factors like ageing, smoking and poor diet can lead to lifestyle-related diseases such as diabetes and Alzheimer's disease.

Now, the consortium, led by Gen-Ichiro Soma at the Control of Innate Immunity TRA, Japan, together with Hiroyuki Inagawa (TRA) and Kimiko Kazumura (Hamamatsu Photonics), has developed a simple and effective method of monitoring homeostasis using trace blood samples.

To maintain homeostasis, the body must eliminate xenobiotics — harmful substances including viruses, bacteria, and waste products generated by the body itself. Immune cells called phagocytes attack and consume xenobiotics before they reach toxic levels. If people could monitor their ability to generate fully-functional phagocytes — and control it by the food they eat — lifestyle diseases could be controlled or prevented.

“Excessive xenobiotics in the body — particularly those generated by natural processes — disturb homeostasis, which leads to a decline in quality of life,” says Soma. “We’ve

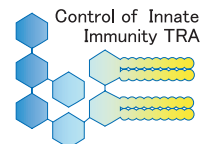
developed three highly sensitive assays that use optical sensing techniques to measure aspects of blood cell activity.” Results from this ‘Simplified Multimodal Homeostasis Evaluation System’ are achieved in seconds, meaning an individual’s health status can be monitored almost in real time.

One of the assays monitors neutrophil activity, a useful marker of oxidation and inflammation, while another determines how well the body is regulating oxidized LDL, a complex of lipids and proteins linked to heart disease and diabetes.

The third assay monitors phagocyte activity to see if they are eliminating xenobiotics effectively. “We measure phagocyte activity using *E. coli* cells labeled with a pH-sensitive fluorescent probe,” explains Kazumura, who designed the assays. “When the *E. coli* cells are phagocytosed by neutrophils in a blood sample, the pH decreases and the fluorescence signal increases.”

Soma’s team hopes that their system could be used to monitor daily changes in health objectively, and inform the best choice of diet — a step closer to what Kazumura calls ‘tailor-made food’.

“We believe our system could monitor differences in homeostatic condition between participants who consume functional foods or a placebo. We are planning an initial human trial with brown rice,” says Inagawa. “We will also use animal models and human case-studies to examine the effects of life-style diseases on homeostasis.” ■



Multimodal Homeostasis Evaluation  
Development Group Consortium  
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# A HEALTHY OLD AGE THROUGH FUNCTIONAL FOODS

Researchers, food manufacturers and political will are the drivers behind **A MAJOR JAPANESE RESEARCH PROJECT** to develop new functional food products.

## The aim of the Functional and Agricultural Food Products for the Next Generation Project

(part of the SIP) is to develop new food products that will help ensure a good quality of life for the country's ageing population.

The central ethos of the project is that medicine and food are isogenic, meaning that food and medicine can overlap, especially when chemicals with

specific beneficial functions are an integral part of food.

The programme gives us the opportunity to explore what we think of as three priorities for any area of research — in this case, they underscore the importance of agricultural and food scientists to explore basic science together.

The first is finding and analyzing pre-disease markers for evaluation and verification

of functional foods preferably at molecular and cell levels.

The second is that the markers, if available, would be useful for improvement of the quality of life of aged individuals and their healthy longevity. It is not enough to live for a long time, the quality of life must not diminish as our population ages. The marker science would be useful for analysis of correlations between eating and longevity in cohort studies to be conducted all over the world.

Finally, it is crucially important to construct a triangular industrial-ministerial-academia platform that would positively accelerate commercialization of food products developed from basic studies. It will contribute to the interaction of these three different research areas and also to bringing up young food scientists who will play an active role in the future.

Thus the start of this SIP in the Ministry of Agriculture, Forestry and Fisheries is of

pressing importance, both scientifically and industrially. Food companies will no doubt be activated and compete with each other, which will contribute to the strategic innovation of agricultural industries in the world as well as in Japan.

This collaboration between academia and the 46 participating companies is handled by Kengo Akimoto, Director of Research & Development Department of Japan Bioindustry Association. The following food companies also contributed funding for this advertisement feature: Asahi Group Holdings, LTD., Lotte Co., Ltd., Toyo Institute of Food Technology, Nisshin Seifun Group Inc., Nippi, Incorporated, Ito En, Ltd., Fuji Oil Holdings Inc., Nippon Flour Mills Co., Ltd., Suntory Holdings Limited, T. Hasegawa Co., Ltd., and Kirin Company, Limited. ■



The University of Tokyo  
www.jba.or.jp/pc/en/inquiries-sip.html



Asahi Group Holdings, LTD.  
www.asahigroup-holdings.com/en



LOTTE Co., Ltd.  
www.lotte.co.jp



TOYO INSTITUTE OF FOOD TECHNOLOGY

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www.shokuken.or.jp/en



Nippi, Incorporated  
www.nippi-inc.co.jp/english/tabid/74/Default.aspx



Nisshin Seifun Group Inc.  
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