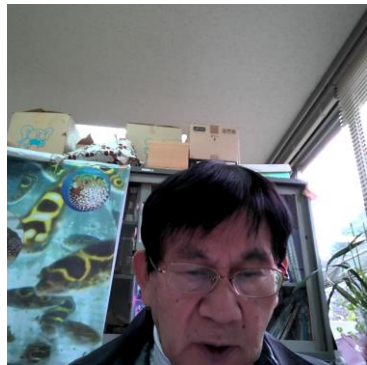
Acceptability of Dishes with Soy-Based Meat Substitute and Their Effects on Blood Biochemistry in Vietnamese T2DM Patients

Shigeru Yamamoto, Professor, Ph.D., RD

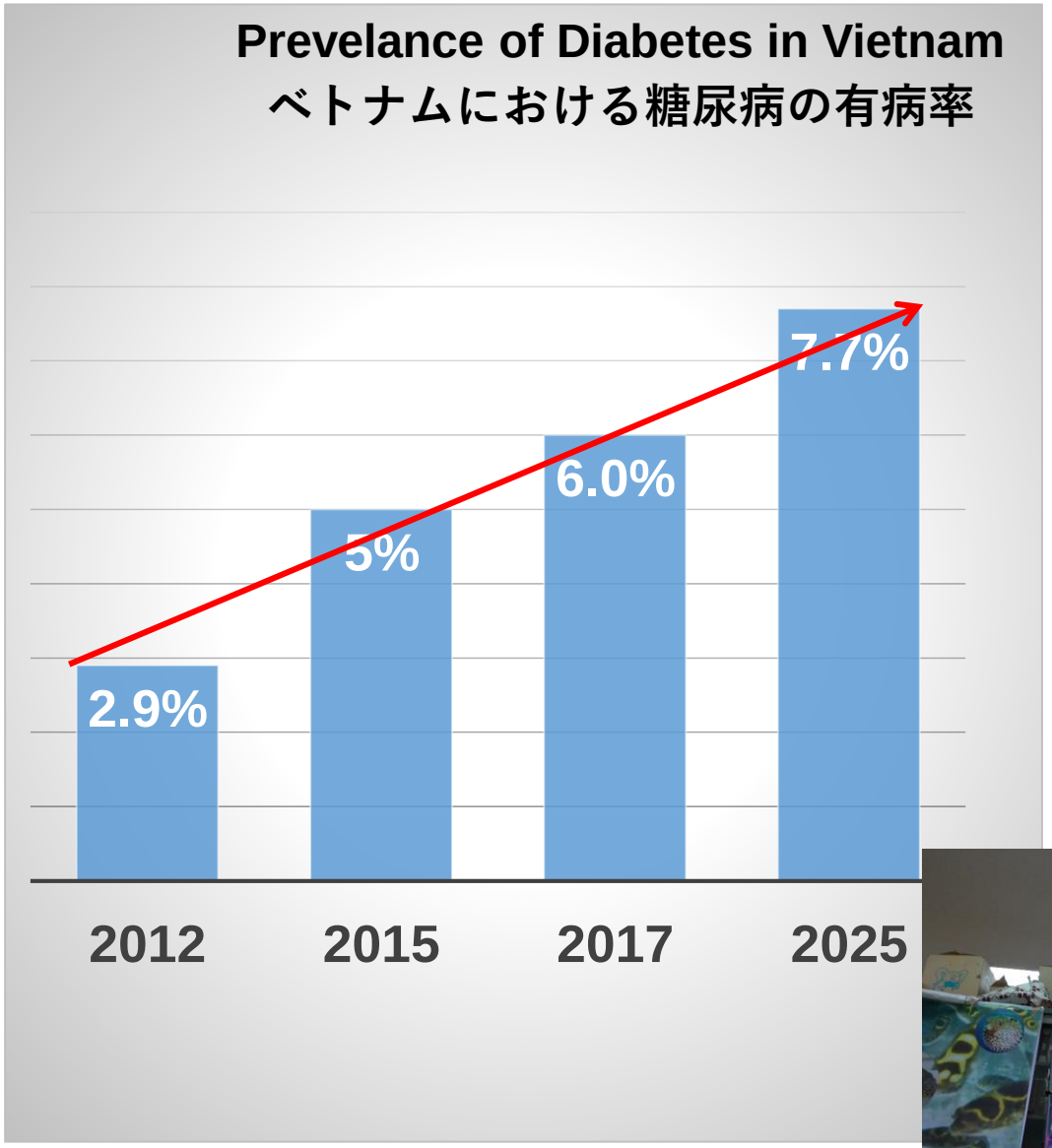
International Nutrition, Department of Food and Nutritional Sciences、

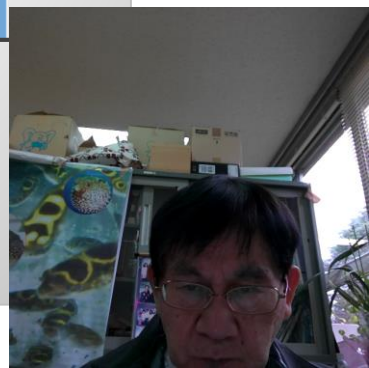
Graduate School of Human Life Sciences, Jumonji University,



Top 10 causes of death in Vietnam-2018

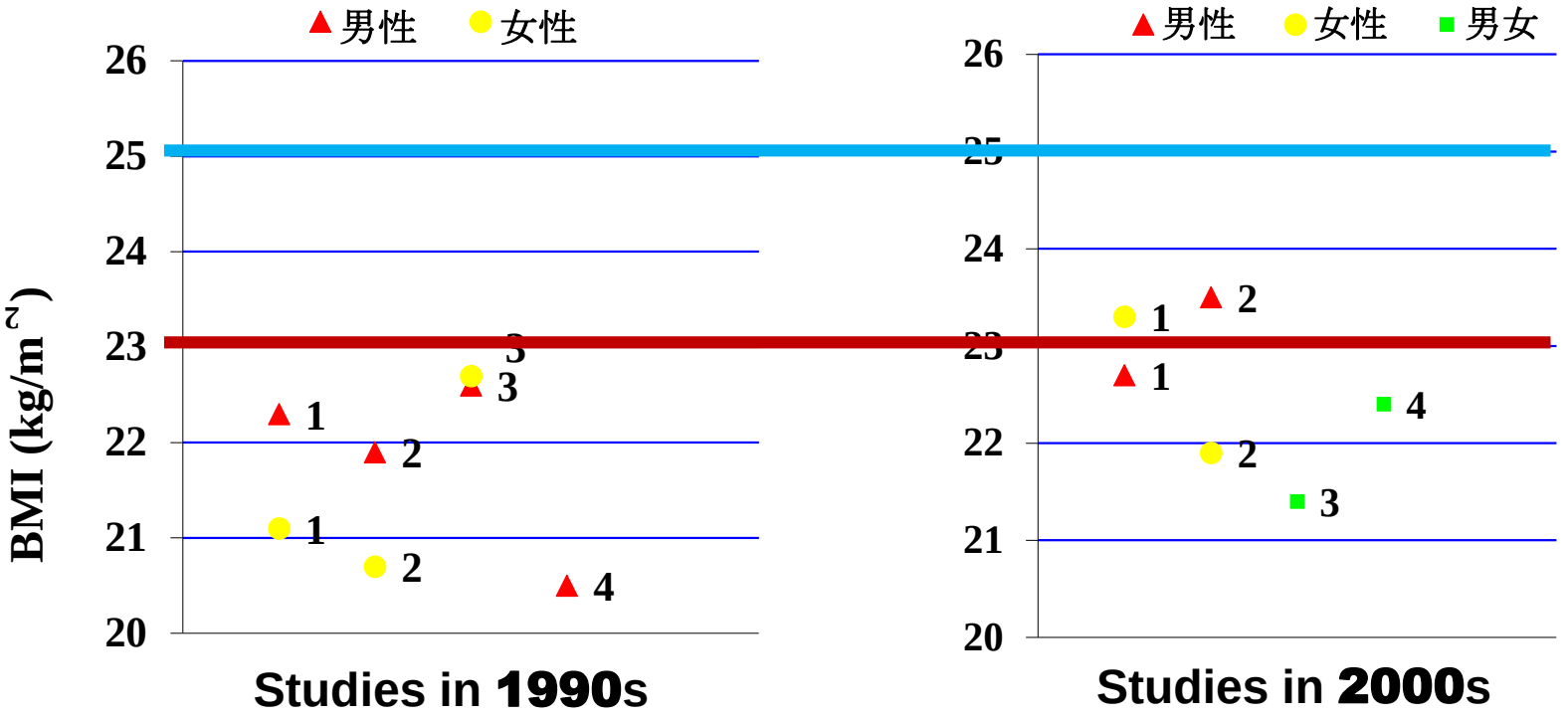
1. Stroke (No. 1 cerebral infarction)
2. Ischemic heart disease
3. Lung cancer
4. chronic obstructive pulmonary disease
5. Alzhemerer's
6. **Diabetes**
7. Cirrhosis
8. Injuries
9. Lower respiratory injections
10. Tuberculosis





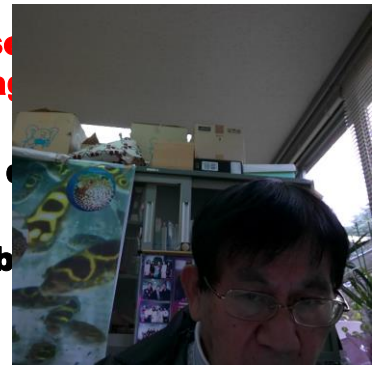
BMI of Vietnamese Type 2 DM is rather normal

I think that the major cause is low fiber intake (<10g/day in adults)



1. Study in 241 patients in inpatients unit of NTP hospital (Quynh et al)
2. Study in 629 patients in inpatients unit of NDGD (Thuy et al)
3. Study in 504 BN ĐTĐ (Dat et al)
4. Study in subjects with insulin resistance (Minh et al)

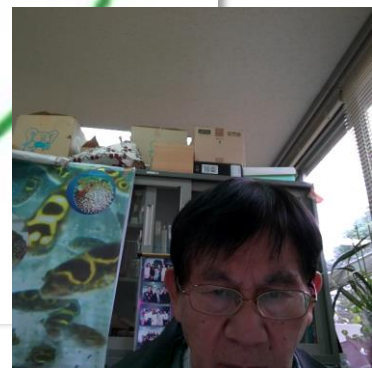
1. Epidemiological study on diabetes in 2932 subjects in Ho Chi Minh City (Son et al, 2004)
2. A cross-sectional study in 48 newly diagnose patients and 96 normal subjects (matched by a locality) (Son et al 2004)
3. Epidemiological study on diabetes in three Hanoi city with 2017 subjects (Hai et al, 2001)
4. Epidemiological study on diabetes in 3286 sub Giang province (Tuan et al, 2003)



- **In the United States, soybean meat made from plants is often used for meat patties sandwiched between hamburgers.**
- **The trend is coming to Japan, and since 2020, the commercialization of hamburgers using substitute meat is progressing.**
- **Moreover, its taste is not so different from the original meat, and it seems to have the advantage of having less calories and higher nutritional value than meat.**

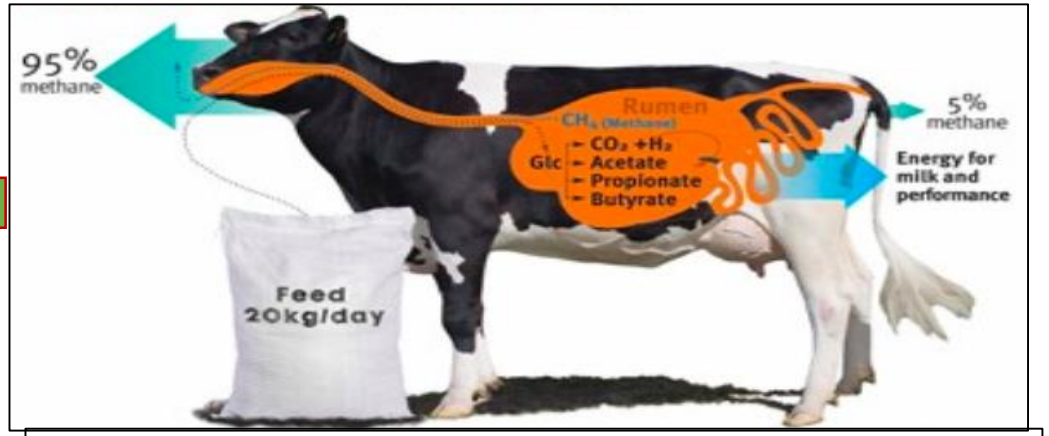
Meat Free Monday (2009) started by a member of Beatles Paul Mc Cartlney

How we can make a positive difference in slowing climate change, preserve natural resources, and better our health by having at least one plant-based day a week.



We can save earth eating less meat

Methane Gas (CH4)
from livestock contribute 14.5 %
of global greenhouse gas emissions*



The digestion of cow feeds is first done by stomach bacteria. At that time, a lot of methane gas can be produced.

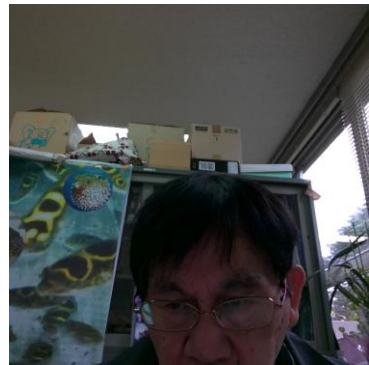
The demand for meat is increa
more cows are needed

Source: Report by the United Nations Food and Agriculture Organization (FAO), 2016.

Textured Soybean Protein (Soy-based meat substitute) (Soy meat)

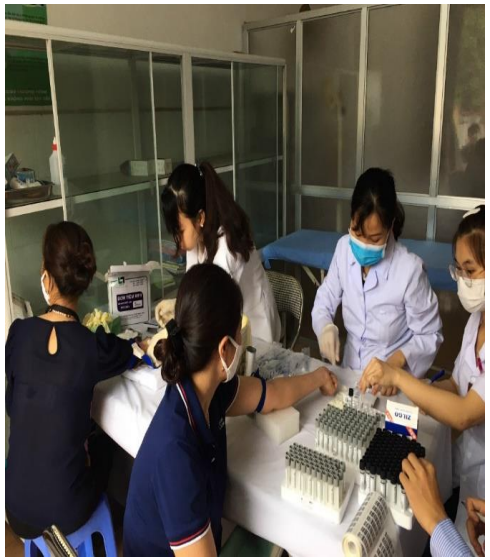
- Through the process of compressing at high pressure and temperature by Extruder, a porous texture which rich in fiber (13.6g/100g) is formed.
- High firber concentration in soy meat is expected to be a diet treatment for diabetic patients.

Effects of Soy Meat on improving blood glucose, lipid profile in type 2 diabetics



Subjects

The study was approved by the ethical committee of Hai Duong Medical Technical University- a surburb of Hanoi City.



The following patients were screened from 1500 medical records at a university hospital.

Blood biochemical examination of 120 subjects

Invited 47 subjects

Randomly

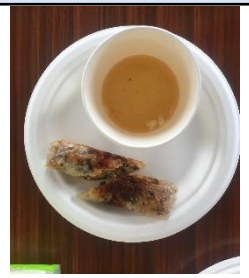
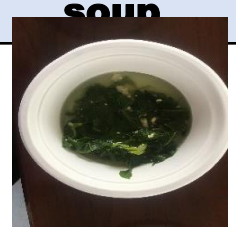
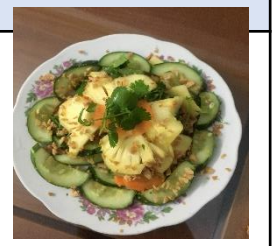
- **Intervention group 介入群**
- **Control group 対象群**

- ✓ Age 40-65 years old
- ✓ 7%<HbA1<8.5%

- ✓ FBG >6.5 mmol/l
- ✓ Fructosamine>285µmol/dl
- ✓ Dyslipidemia (TC, TG,HDL, LDL)

- ✓ Medication and physical activity dose not change during the study.
- ✓ Provide consent inform

Creating delicious soy meat dishes

Name of dishes	Spring roll	Korokke	Steam egg	Cabbage roll	Mixed vegetable	stir-fried morning glory	Luffa, Sayte bean sprout	Fried egg
								
Name of dishes	**Guard soup**	**Tomato sauce**	**Katuk soup**	**Mustard soup**	**Potatos soup**	**Vine spinach soup**	**Smash porridge**	**Salad cucumber**
								

We have created a soy meat dish that is as delicious as real meat and does not smell like soybeans.

5 Day Cycle Menus

The best 10 dishs for intervention trials in T2DM patients

	Day 1	Day 2	Day 3	Day 4	Day 5
Dish 1 Main dish	 Spring roll	 Mixed vegetable	 Stir-fry glory morning	 Luffa, Sayte bean sprout	 Salad
Dish 2 Soup	 Vine spinach soup	 Mustard soup	 Katuk soup	 Soup guard	 Jute plant soup

The amount of 40g Soybean- Meat (contains 6g fiber) was used.

Sensory Test

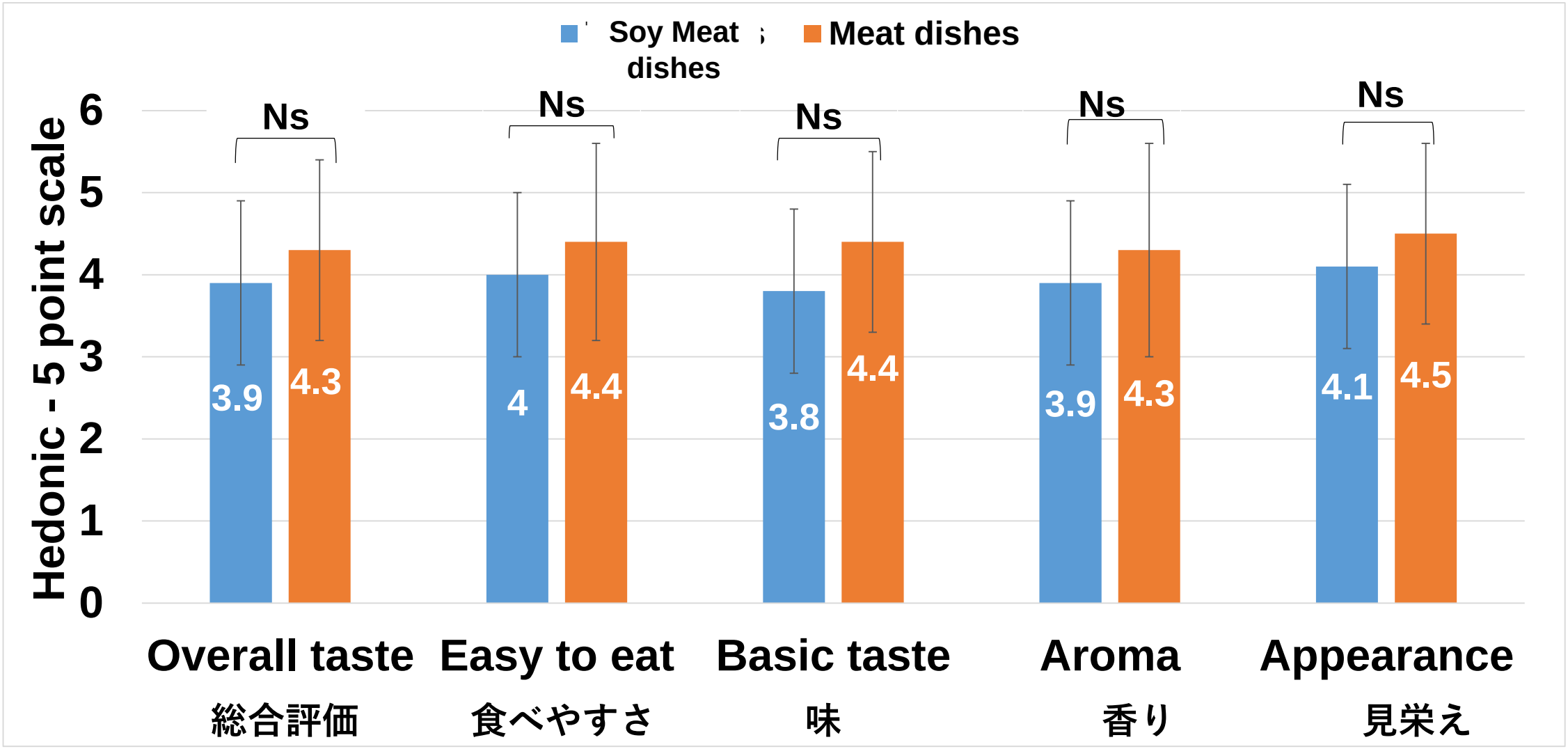
Cooking

- 10 dishes using Meat for the control group.
- 10 dishes using Soy Meat (the same receipts) for the intervention group.

Sensory test
官能検査

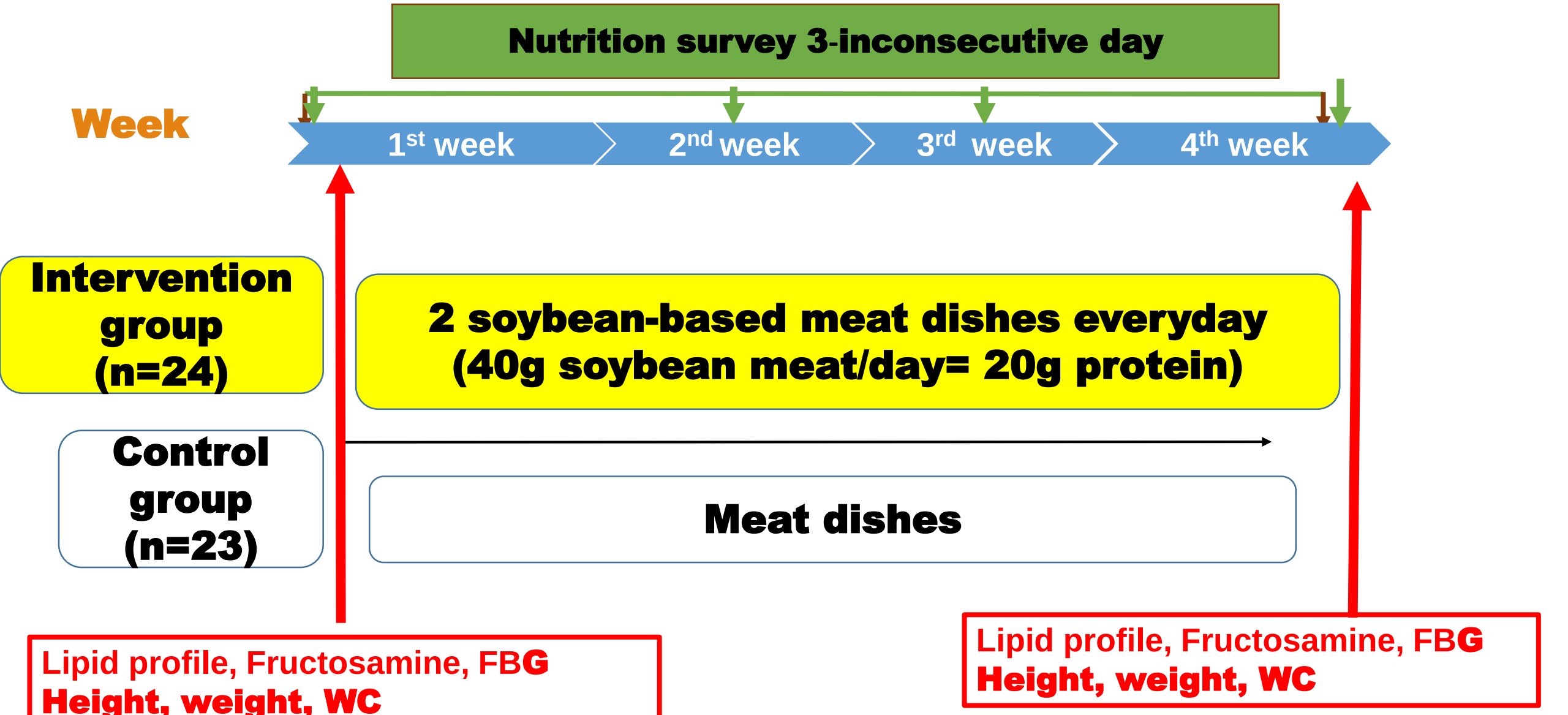
Interview and **ask for score** of each dishes by **Hedonic-5 point scale**

Results of Sensory Test



Significant diffirent at $p < 0.05$ by Paired student *t*-test

Study design

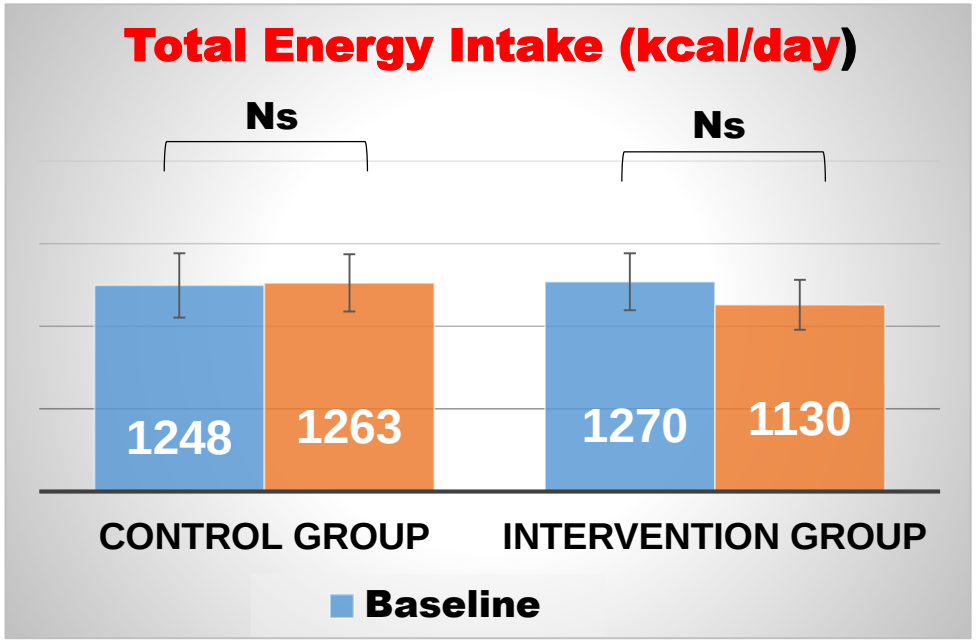


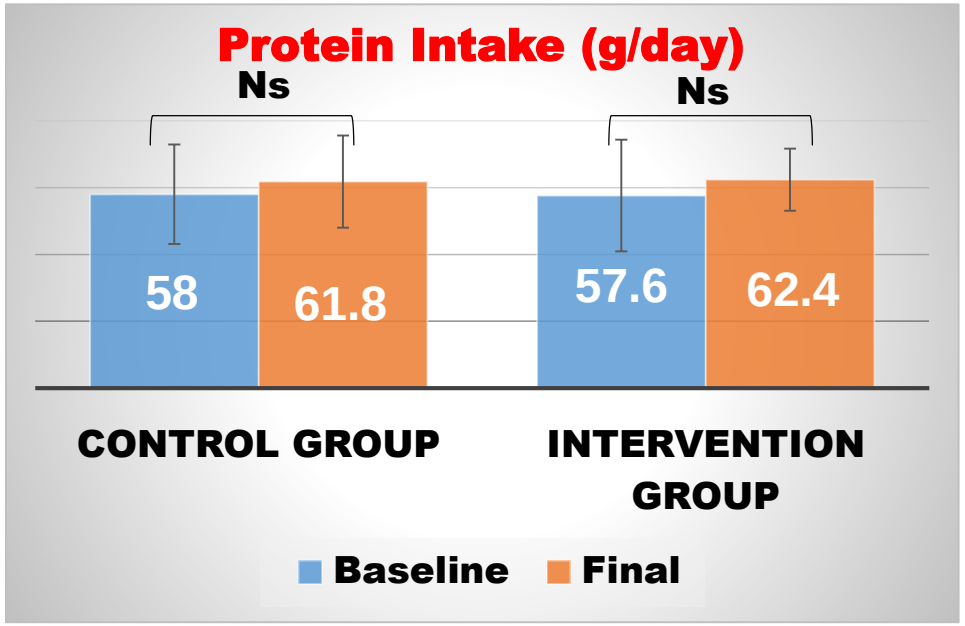
Anthropometric indices at baseline and final

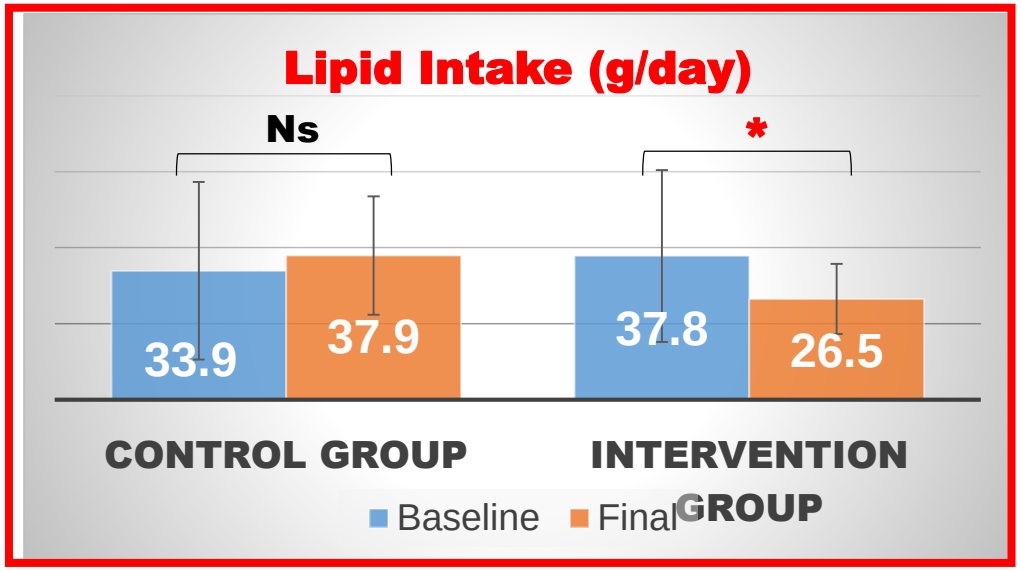
Variables	Control group Age 59.1±7.5 N=23 (14, M 9)			Intervention group Age 59.1±7.5 N=23 (15, M 9)		
	Baseline	Final	P	Baseline	Final	P
Weight (kg)	59.3±10.1	58.9±10.1	0.06	59.9±8.9	59.3±8.9	0.15
BMI (kg/m2)	23.6±2.7	23.4±2.9	0.5	24.3±2.9	24.0±3.1	0.23

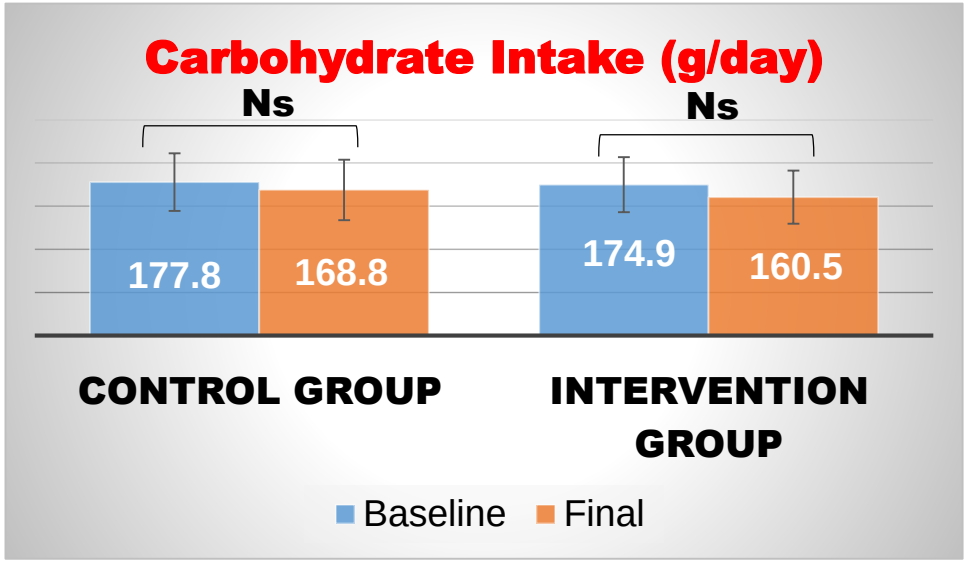
Significant diffirent at $p < 0.05$ by Paired student *t*-test

Energy and nutrient intakes at baseline and final



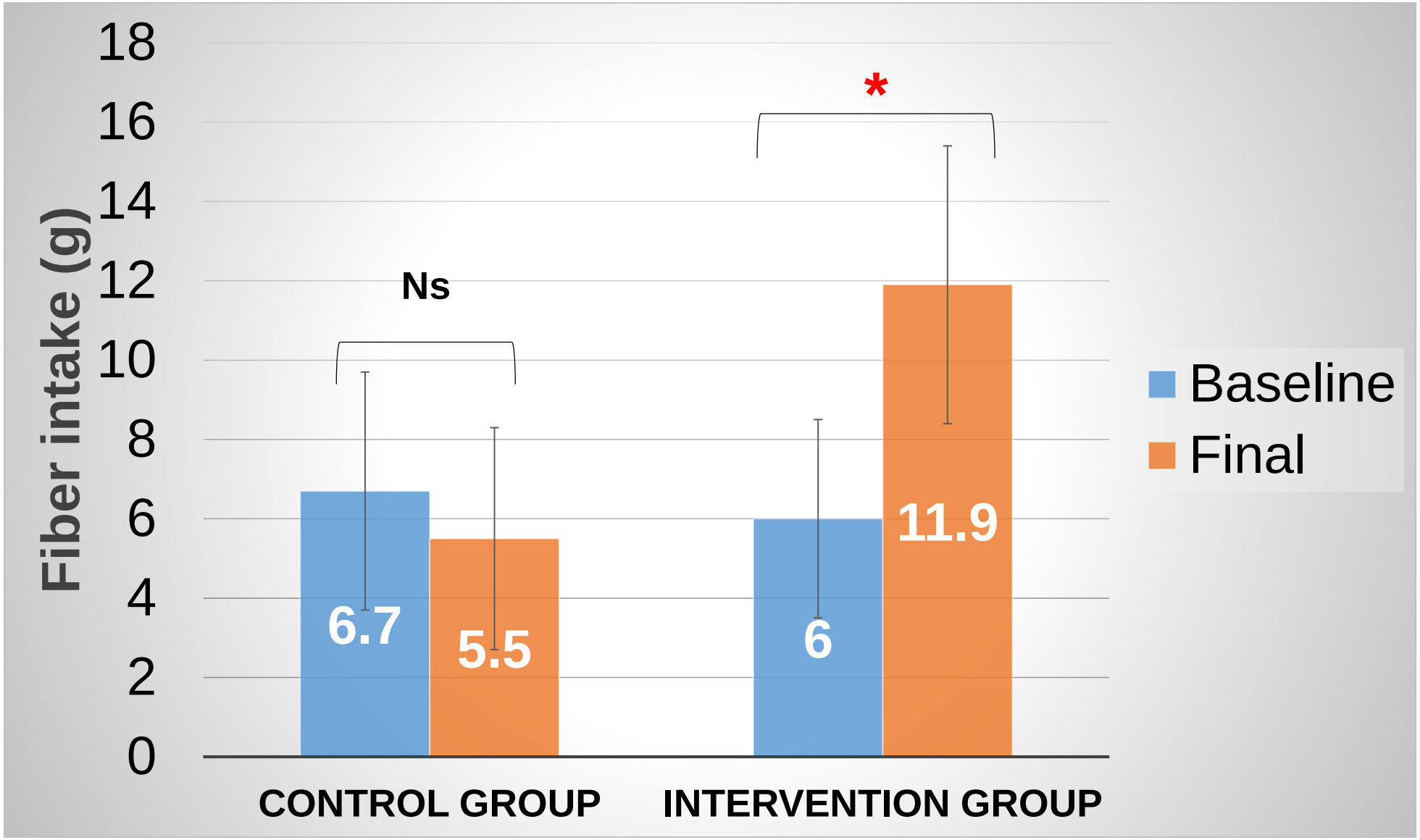






*** Significant diffirent at p < 0.05 by Paired student *t*-test**

Fiber intake at baseline and final



* Significant diffirent at p < 0.05 by Paired student *t*-test

Blood biochemical data at baseline and final

Variables	Control group (n=23) Mean ± SD			Intervention group (n=24) Mean ± SD		
	Baseline	Final	P	Baseline	Final	P
FBG (mmol/l)	8.3±2.1	8.7±2.2	0.58	9.5±3.7	9.3±3.2	0.71
Fructosamine (μmol/l)	339.8±44.8	341.2±43.5	0.84	362.6±86.2	347.1±82.3	0.03*
T-C (mmol/l)	5.4±1.2	5.3±1.4	0.75	5.2±0.9	4.8±0.8	0.02*
TG (mmol/l)	3.4±2.2	3.7±2.8	0.43	3.5±2.2	2.8±2.0	0.02*
LDL-C (mmol/l)	3.2±0.7	3.3±0.9	0.32	2.9±0.8	2.8±0.6	0.70
HDL-C (mmol/l)	1.4±0.3	1.2±0.4	0.01*	1.3±0.3	1.2±0.3	0.07

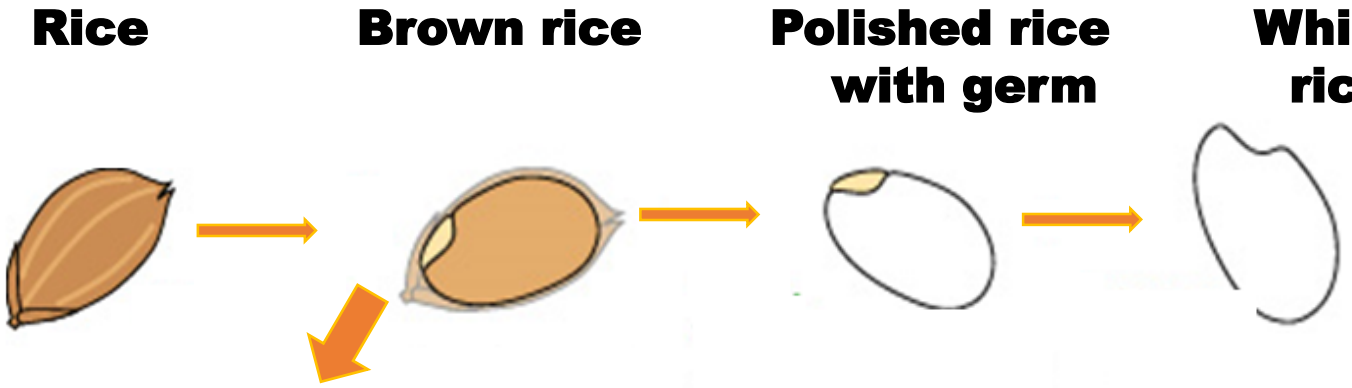
Significant diffirent at $p < 0.05$ by Paired student *t*-test

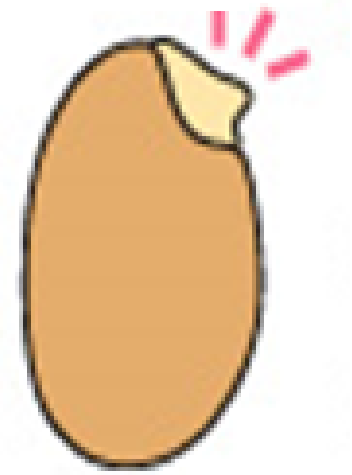
Our previous 3 studies:

Effects of fiber intake in Vietnamese T2DM

1. Pre-germinated Brown rice 2. Vegetables and fruits 3. Okara

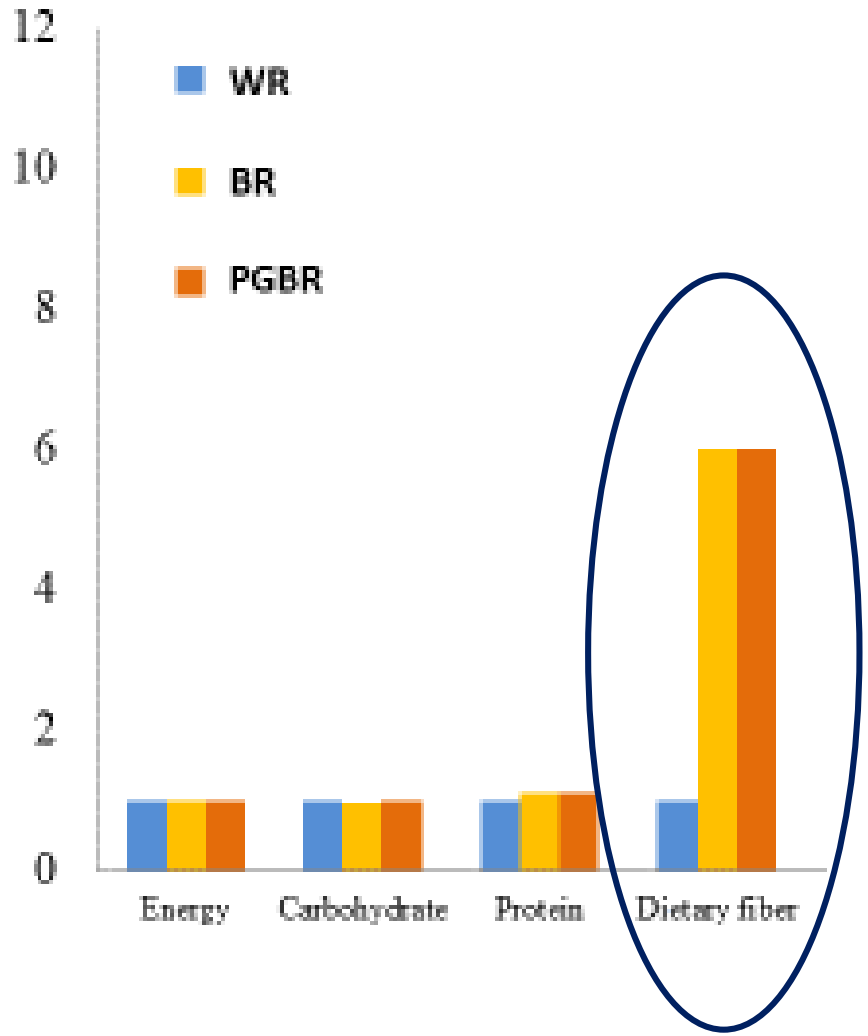
Pre-germinated brown rice (PGBR)





Pre-germinated brown rice (PGBR) is made by soaking brown rice in water for about 24 hours. It is slightly germinated. PGBR contains 6 times more fiber than WR.

Brown rice needs special cookware, but PGBR can use the same cookware as white rice.



How to make pre-germinated brown rice (PGBR)

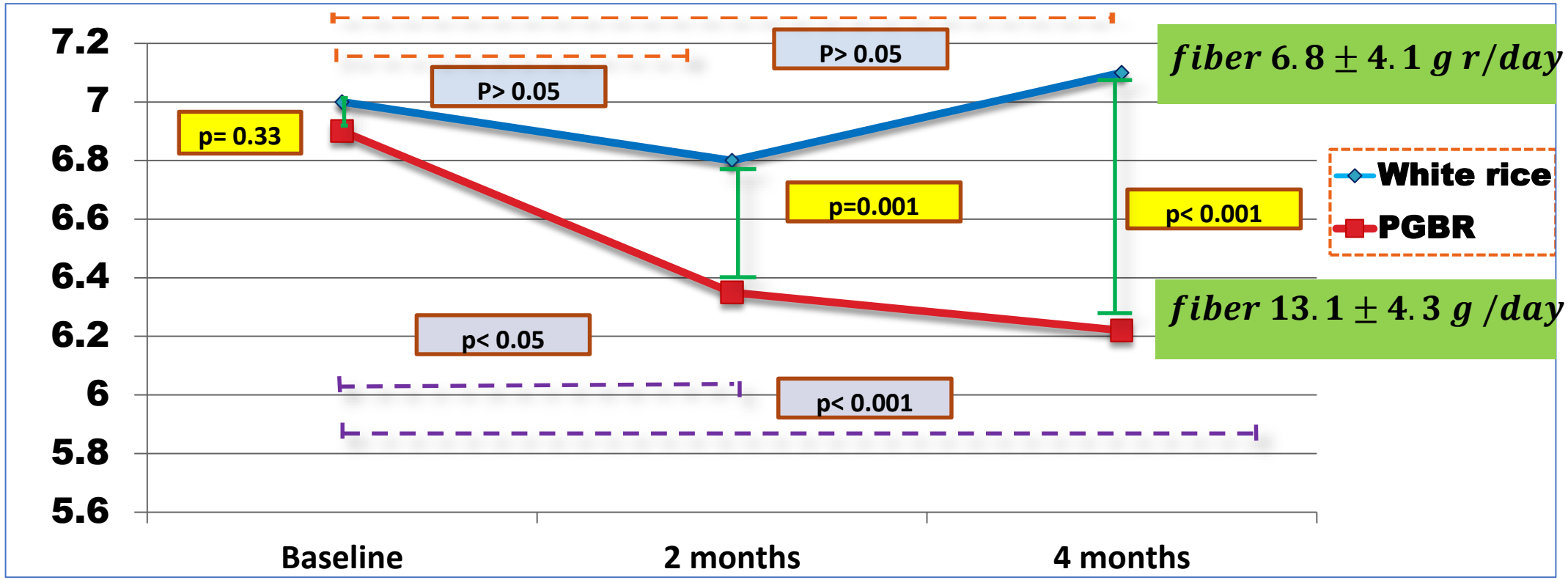
The brown rice was soaked in lukewarm water at 30 degrees Celsius for about 20 hours.
When it had sprouted about 1 mm, it was dried.

Energy and nutrient intakes

Variables	Baseline				Final		
	PGBR (n=28)	WR (n=27)	p-value		PGBR (n=28)	WR (n=27)	p-value
Energy (kcal)	1485±381	1453±360	0.758		1448±329	1462±256	0.86
Carbohydrates (g)	228±63.7	237±65.5	0.63		237±57.4	231±59.4	0.689
Protein (g)	60.4±15.3	61.2±20	0.87		61±15.4	58.2±11.6	0.44
Lipid (g)	35.9±18.6	29.1±11.6	0.11		28.7±9.2	34±11.1	0.56
Dietary fiber (g)	7.9±4.8	7.9±3.2	0.959		10.9±4.6	7.7±3.2	0.05

*Data are mean±SD. P-values obtained by unpaired *t*-test

PGBR reduced HbA1c of DM patients dramatically



As a staple food, WR or PGBR was given for 4 months. A remarkable effect was seen in PGBR group. The main reason seems to be the difference in fiber intake. The fiber intake was 6.8 g in WR group, but 13.1 g in PGBR group.

Pre-germinated brown rice reduced both blood glucose concentration and body weight in Vietnamese women with impaired glucose tolerance. Nhung et al 2014)

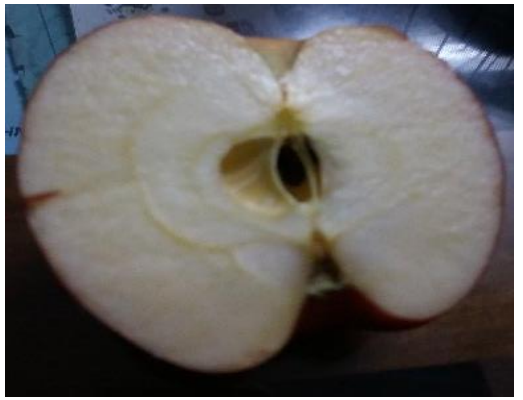
Effects of vegetable and fruit intakes on blood glucose concentration

Vegetable consumption was about 230g/day (2020) which **meet only half of recommendation.** Popular vegetable in Vietnam has **low in fiber** < 2g per 100g

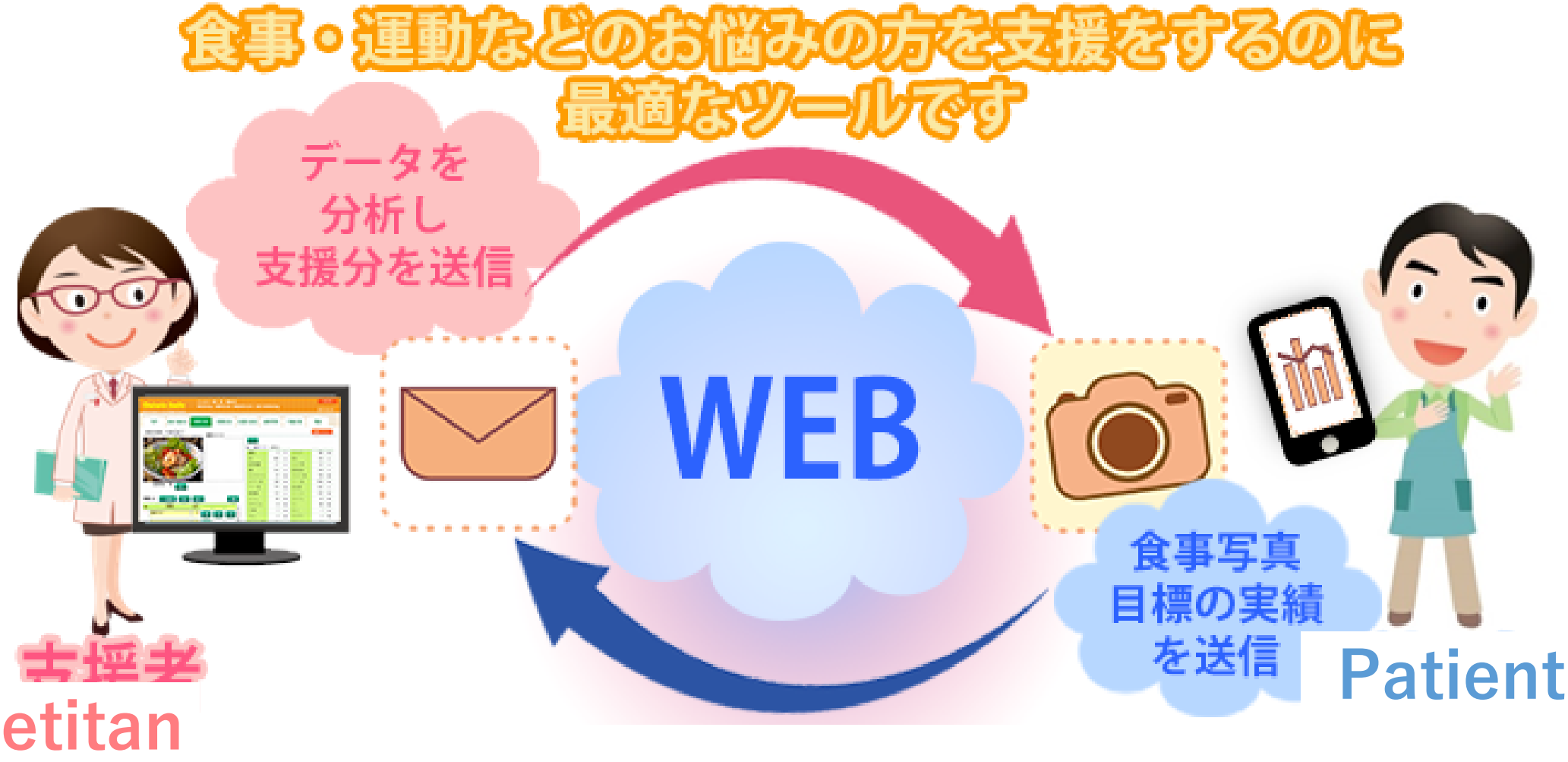






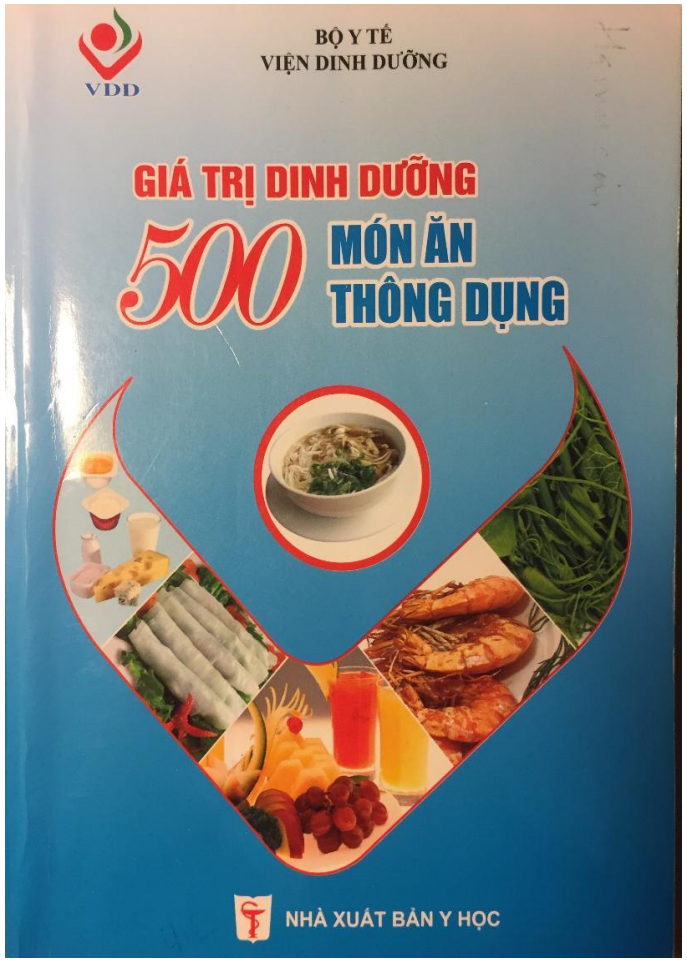


Nutritional Support Software: Calorie Smile

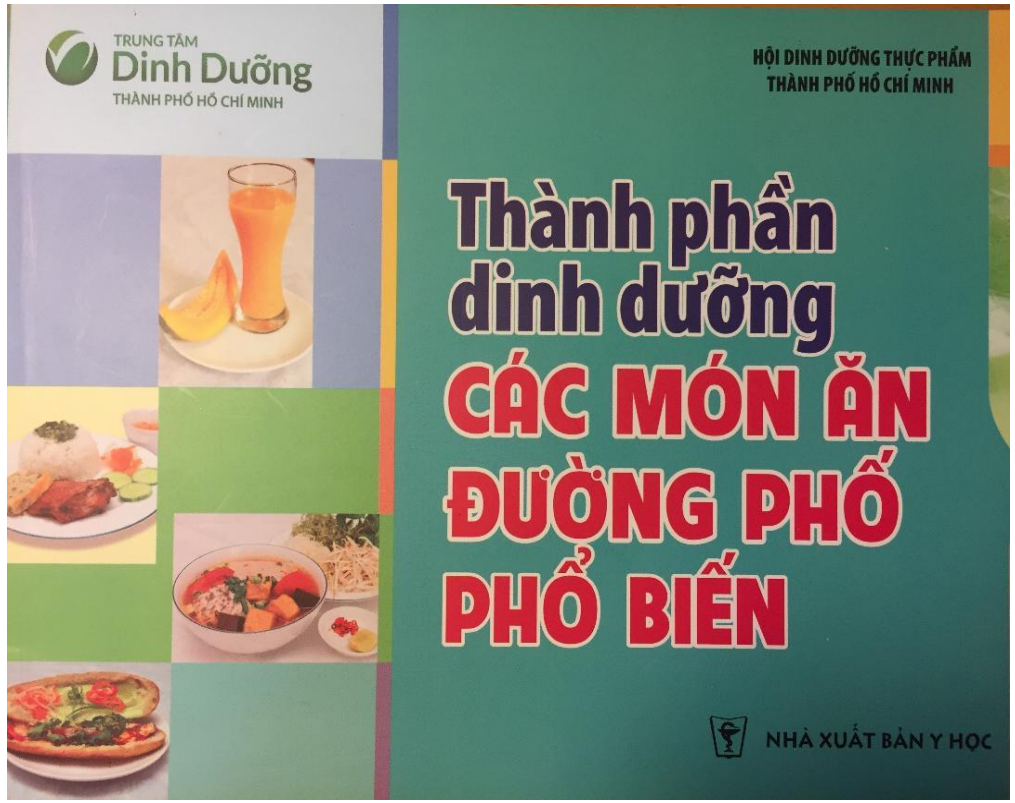


The advantage of this software is that patients can receive nutritional guidance without having to come to the hospital.

Vietnam Food Composition table



Photos of 500 dishes and nutrients in Hanoi



Photos of 400 dishes and nutrients in HCM

CSVには、これらのデータが入力されています

Asian Journal of Dietetics, 2020

Research Note

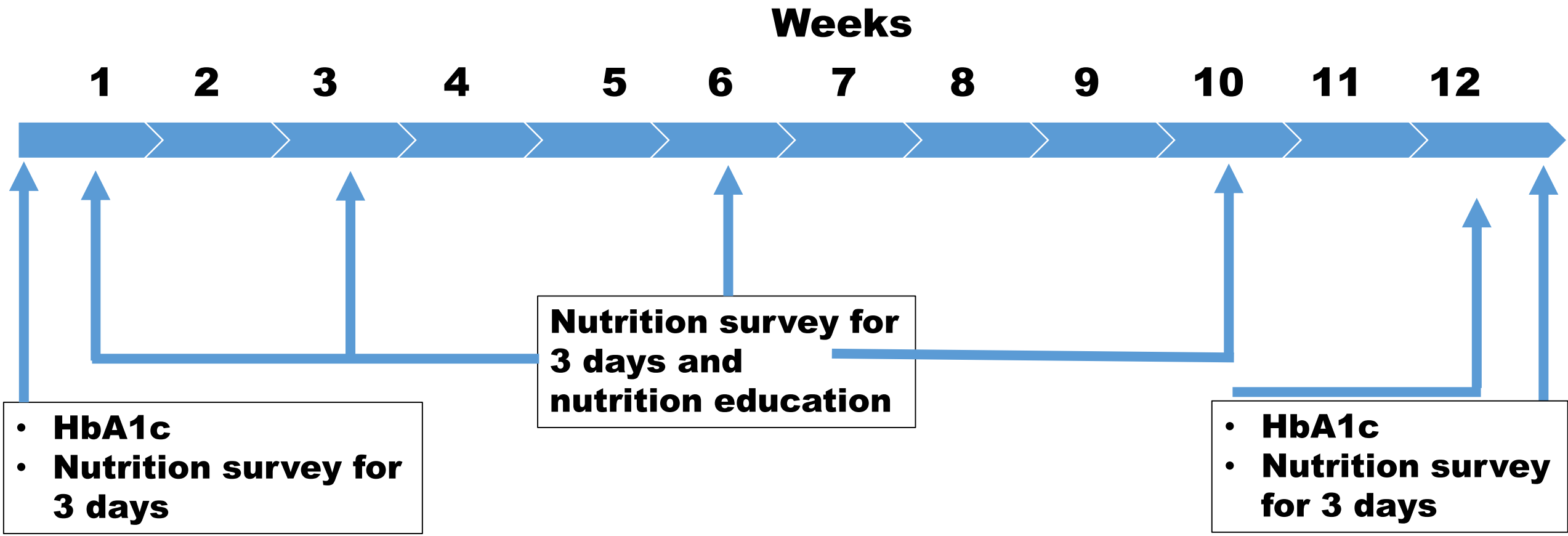
Validation of Calorie Smile Vietnam Software for Measuring Food Intake

Nguyen Huong Giang[1*], Ta Thi Ngoc[1], Nguyen Mai Phuong[1], Ngo Thi Thu Hien[1], Nguyen Thuy Linh[2], Vu Thi Thu Hien[3], Hitoshi Iizuka[1], Fumio Shimura[1], Shigeru Yamamoto[1],

[1]*Jumonji University Niiza, Saitama Prefecture, Japan*
[2]*Hanoi Medical University, Hanoi, Vietnam*
[3] *National Institute of Nutrition, Hanoi, Vietnam*

ABSTRACT *Background and purpose*. Achieving accuracy and precision in assessing diet is a challenge. Food weighing (FW) is the "gold standard" method for dietary estimation. However, this method is time-consuming, costly, and disruptive. Traditional methods such as 24h recall, diet record and food frequency questionnaires are mostly used today but these depend largely on the participants' memory. A new Vietnamese version of a nutrition support software called "Calorie Smile Vietnam" (CSV) has been developed and has a food-measuring intake function. The purpose of this study was to test the validity of CSV

Vegetable intervention by education



Baseline characteristics of the population by Study group

	Intervention Group (n=30)	Control Group (n=30)
HbA1c (%)	**8.17±0.73**	**8.05±0.77**
Age (years)	**57.8±9.0**	**60.6±8.2**
Years with diabetes	**6.0±4.3**	**6.5±5.9**
Sex		
Female	**20**	**20**
Male	**10**	**10**
BMI (kg/m^2)		
<18.5	**0**	**0**
18.5-24.9	**20**	**20**
≥25	**10**	**10**

P values obtain from unpaired *t*-test between intervention and control groups

Comparison of vegetable and fruit intake at baseline and final of intervention and control group

	Intervention group (n=28)		Control group (n=30)	
	Baseline	Final	Baseline	Final
Vegetable and fruit intakes (g)	234 ± 130	326 ± 173*	161 ± 118	187 ± 132

*Significantly different from baseline to final within the group ($p<0.05$)

Energy and nutrient intakes at baseline and final

	Intervention group (n=28)		Control group (n=30)	
	Baseline	Final	Baseline	Final
Energy (kcal)	1399±294	1377±234	1398±315	1378±296
Protein (g)	66.4±18.3	62.6±16.9	61.5±15.7	58.9±17.1
Fat (%E)	26.3±6.2	24.9±3.1	24.7±4.3	25.5±3.8
Carbohydrate (%E)	54.7±8.2	57.1±4.4	57.7±5.5	57.6±4.9
Fiber (g)	6.4±2.5	8.3±3.0***	5.5±1.8	5.9±2.1

*** Significantly different from baseline to final within the group ($p<0.0001$)

Comparison of HbA1c at baseline and final of intervention and control group

	Intervention group (n=28)		Control group (n=30)	
	Baseline	Final	Baseline	Final
HbA1c (%)	8.16±0.75	7.79±0.8*	8.05±0.77	8.39±1.33

*Significantly different from baseline to final within the group ($p<0.05$)

結果

	A群　（発芽玄米群）(n=28)				B群　（白米群）(n=27)		
	Before	After	p–value		Before	After	p-value
Weight (kg)	60.06±8.96	60.18±8.97	0.531		57.82±10.38	57.80±10.7	0.964
BMI	23.9±2.39	23.9±2.54	0.688		23.2±2.88	23.2±2.94	0.864
Body fat (%)	30.0±6.3	28.5±6.6	<0.001		29.34±6.6	26.98±6.66	<0.001
Glucose (mmol/L)	9.17±1.80	7.96±2.3	0.021		10.0±1.80	9.73±2.83	0.639
HbA1c (%)	6.92 ± 0.36	6.19 ± 0.77	<0.001		7.03 ± 0.46	7.12 ± 0.84	0.375
TC (mmol/L)	4.96± 0.72	4.75± 0.67	0.122		4.96 ± 0.91	4.74± 0.71	0.296
TG (mmol/L)	2.38±2.00	1.75±0.64	0.083		2.99±2.85	1.87±0.92	0.029
HDL-C (mmol/L)	1.3±0.135	1.22±0.17	0.071		1.31±0.16	1.17±0.16	0.003
LDL-C (mmol/L)	2.82±0.50	2.84±0.51	0.851		2.84±0.87	2.87±0.57	0.798

*Data are mean±SD. P-values obtained by paired *t*-test.

Okara fiber controlled blood glucose in Vietnamese type 2 Diabetes Mellitus

Okara is a by-product of making tofu. Okara is a by-product of making tofu. It is mainly the soybean skin and fiber.

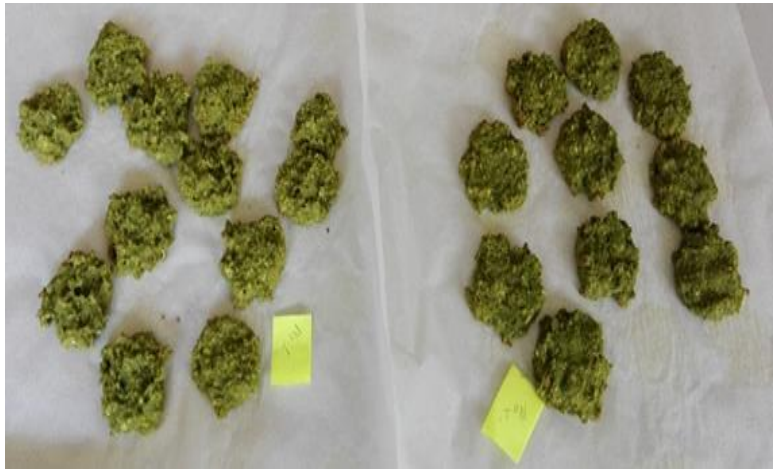
In Japan, it is used as human food, but in Vietnam, it is used as animal feed.

How to get Okara

tofu shop by product

Home made soybean milk residue

New Vietnamese menus with Okara



Methodology

Design: Intervention study

	Control	Okara
n	30	30

2 weeks intervention

Baseline	First week	Second week

We contacted to the subjects every day and ask Okara consumption

- **Nutrition education**
- **Anthropometric Measurements**
- **Blood Collection**

We had nutrition education and gave subjects Okara menus

Energy and nutrient intakes

Variables	Control group n=30			Okara group n=28		
	Baseline	Final	p-value	Baseline	Final	p-value
Energy (kcal)	1378±366	1453±512	0.56	1084±402	1139±312	0.99
Carbohydrates (g)	191.9±58.9	200.8±71.4	0.71	166.9±51.6	165.1±53.3	0.39
Protein (g)	66.6±42.8	70.6±31.6	0.85	53.9±25.9	59.7±21.4	0.14
Lipid (g)	46.5±24.8	40.3±24.1	0.33	22.3±17.3	26.7±13.8	0.13
Dietary fiber (g)	6.6±3.5	8.0±4.4	0.22	7.5±7.1	13.4±4.4	<0.01
Dietary Okara (g)	0	0		0	54±30	

*Data are mean±SD. P-values obtained by unpaired *t*-test

Results of Blood biochemistry

Variables	Control Group n=30			Okara Group n=28		
	Baseline	Final	p-value	Baseline	Final	p-value
Glucose (mmol/L)	6.82 ± 1.61	6.75 ± 1.88	0.638	6.30 ± 1.73	5.39 ± 1.44	<0.05
Fructosamine (µmol/L)	308 ± 40	317 ± 45	0.178	350±40	314±37	<0.01
TC (mmol/L)	4.29 ± 0.93	4.80 ± 1.13	0.032	5.04 ± 1.64	5.01 ± 1.65	0.798
TG (mmol/L)	1.06 ± 0.31	1.16 ± 0.33	0.109	2.13 ± 1.79	2.21 ± 1.75	0.762
HDL-C (mmol/L)	2.60 ± 0.85	3.09 ± 1.18	0.035	1.20 ± 0.30	1.19 ± 0.29	0.598
LDL-C (mmol/L)	2.18 ± 1.21	2.40 ± 2.27	0.293	3.33 ± 1.28	3.30 ± 1.47	0.854

*Data are mean±SD. TC = total cholesterol, TG = triglycerid, HDL-C = high-density lipoprotein cholesterol, LDL-C = low-density lipoprotein cholesterol. P-values obtained by unpaired *t*-test

ありがとうございます。