English for Science

Tennoji High School Attached to OKU

Preface

You can't connect the dots looking forward;
you can only connect them looking backwards.
So you have to trust that the dots will somehow connect in your future.
Steve Jobs

The aim for making this book is to help students develop abilities for presenting their theses and research all over the world. In general, in Japan, it is often said that students who are good at science and math are not good at English. This tendency may be true in our school. To overcome this, I introduced them to online study of English for this academic year (2019), and we focused on developing their abilities to present their theses in front of an audience.

This book was made by students, following our school motto, *independence and freedom*. They had a very hard time making this book, but they had a very good time discussing many different things.

I was given a chance by Dr. Yuri Imura, a geometry teacher at our school, to attend an SSH conference at Ritsumeikan High School. I observed the lesson given by Ms. Nanako Takeda, an English teacher. She gave me a copy of textbook she made for SSH students. This gave me the motivation to make this book.

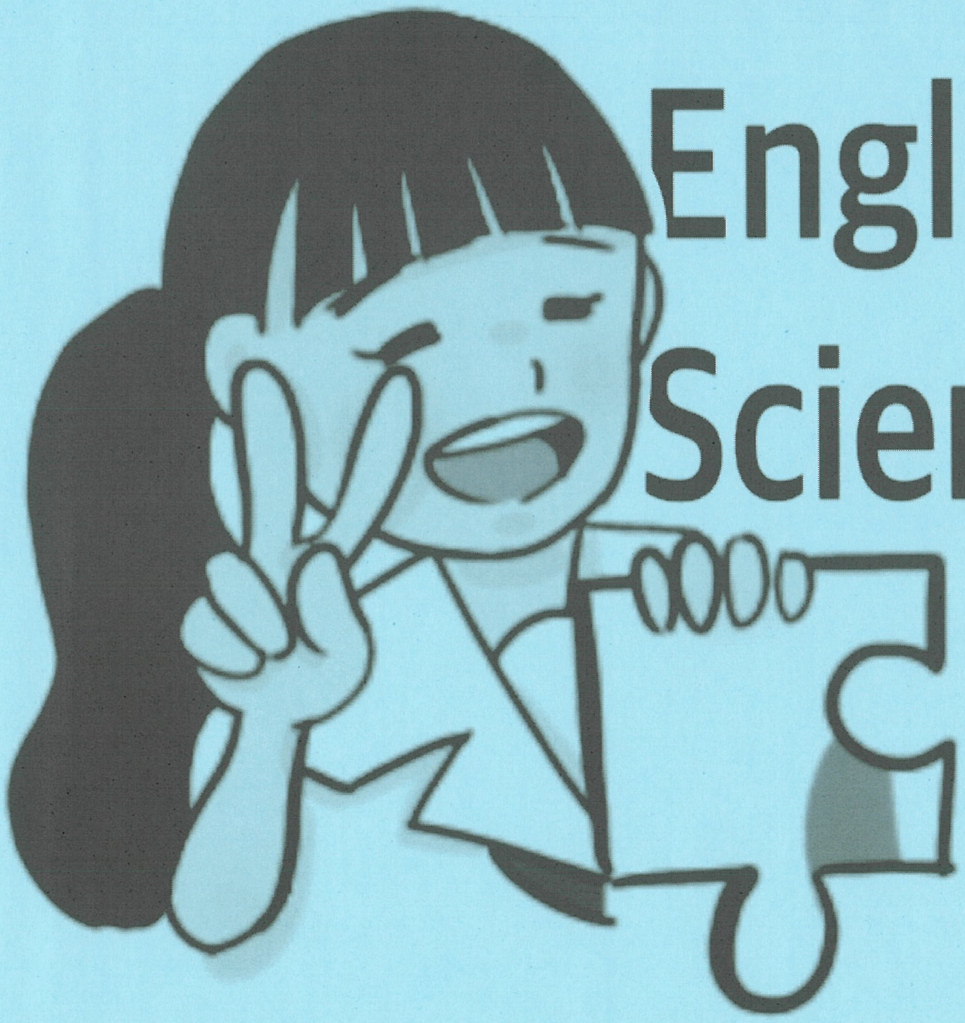
Though the students had a lot of difficulty making this book, they made an attempt to talk and discuss problems with each other. I hope the dot in this time will connect to further dots in their future. This effort will lead them to better lives as scientists.

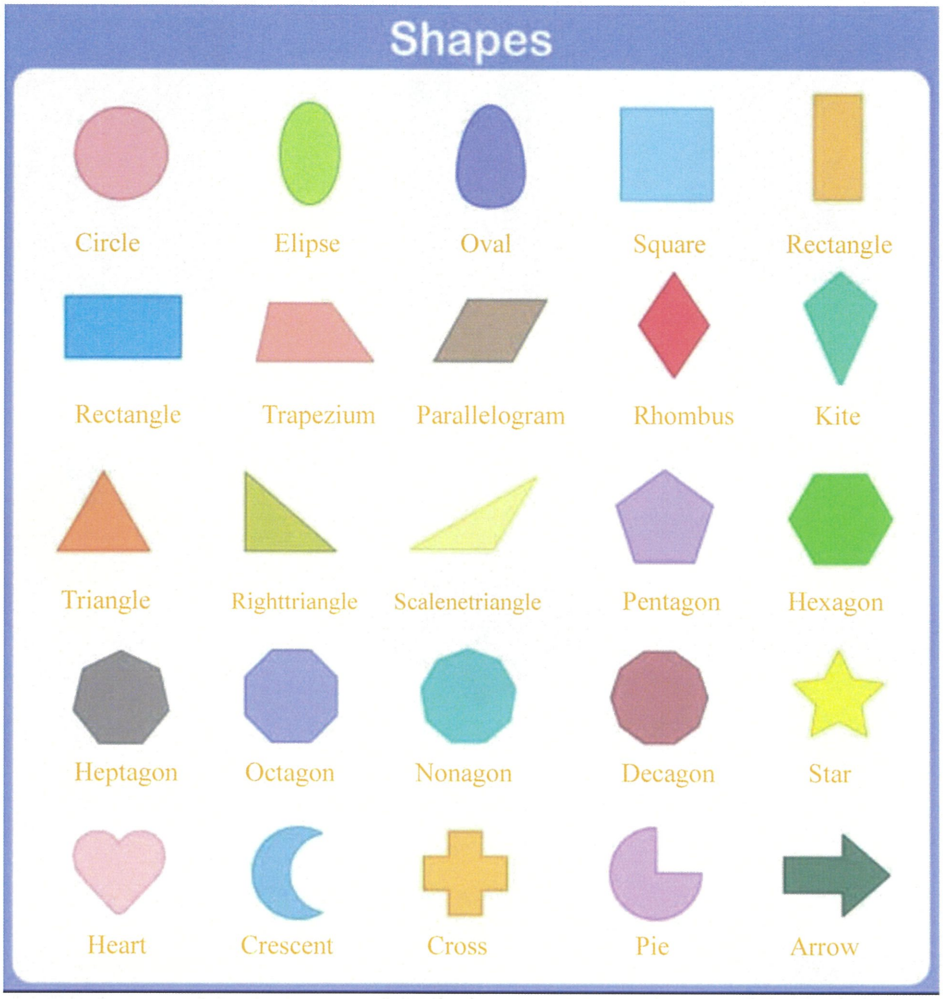
I'd like to show my appreciation for the many teachers and professors who contributed to this project. Mr. Toshiyuki Morinaka, a science teacher and the Head of the SSH committee at our school helped us a great deal in particular. I appreciate the help of Dr. Haruyo Yoshida in Osaka Kyoiku University when I led the students in making their theses and connecting research. She provided me with many chances to present my own theses overseas, and her way of leading me was a model to lead my students. As she did for me, I told my own students to continue to tell themselves "You can do it". Everything she taught me has been very useful for me.

Tennoji High School Attached To Osaka Kyoiku University
English department & teacher for Science English
Madoka Inui

Contents

Basic English for Science





Shapes workbook

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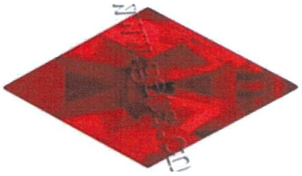

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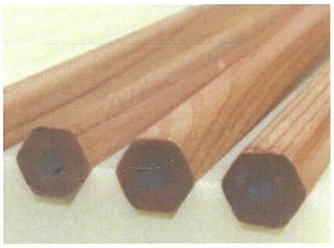

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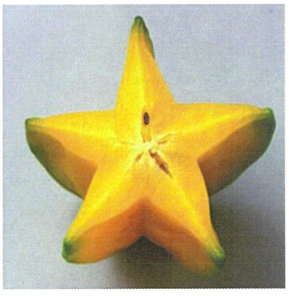

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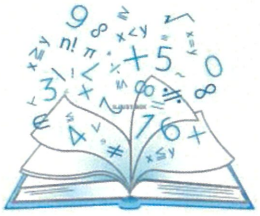
1. Subject

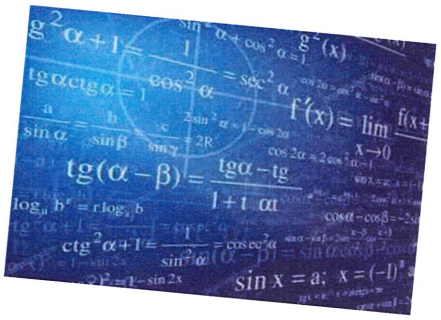
幾何学	Geometry
代数学	Algebra
微積分学	Calculus
解析学	Analysis
統計学	Statistics



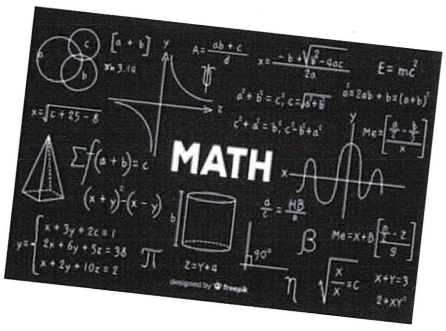
2. Word list

足し算	**addition**
1 + 2 = 3	1 plus 2 equals 3. 1 and 2 is 3.
引き算	**subtraction**
3－2 = 1	3 minus 2 equals 1. 3 take away 2 is 1. 2 from 3 is 1.
掛け算	**multiplication**
3×4 = 12	3 times 4 equals 12. 3 multiplied by 4 equals 12.
割り算	**division**
商	quotient
余り	remainder
7÷2=3 R 1	7 divided by 2 equals 3 with a remainder of 1.
分数	**fractions**
分子	numerator
分母	denominator
1/2	one half /a half
1/3	one third
1/4	one quarter /a quarter one fourth /a fourth
2/3	two thirds
小数	**decimals**
0.34	Zero point three four /point three four
9.05	Nine point oh five /nine point zero five

自然数	natural number
整数	integer
有理数	rational number
無理数	irrational number
正数	positive number
零（０）	zero / cypher
負数	negative number
実数	real number
虚数	imaginary number
複素数	complex number
偶数	even number
奇数	odd number
素数	prime number
絶対値	absolute number
倍数	multiples
最小公倍数	least common multiple / L.C.M
約数	divisors
最大公約数	greatest common divisor / G.C.D.
平方根	square root
立方根	cubic root
累乗根	n-th root
二乗	square
三乗	cube
冪乗	power
指数	index
対数	logarithm



式	expression
方程式	equation
恒等式	identity
関数	function
変数	variables
定数	constant
係数	coefficient
次数	degree
値	values
微分	derivative
偏微分	partial derivative
全微分	total derivative
積分	integral
不定積分	definite integral
定積分	indefinite integral
二重積分	double integral
差分	difference / delta
和分	summation / sum
点	point
直線	straight line
曲線	curve
座標	coordinate
原点	origin
x軸 / y軸	x-axis / y-axis
定義域（変域）	domain
値域	range
象限	quadrant
グラフ	graph



MINI GAME

Make numbers using the playing cards!

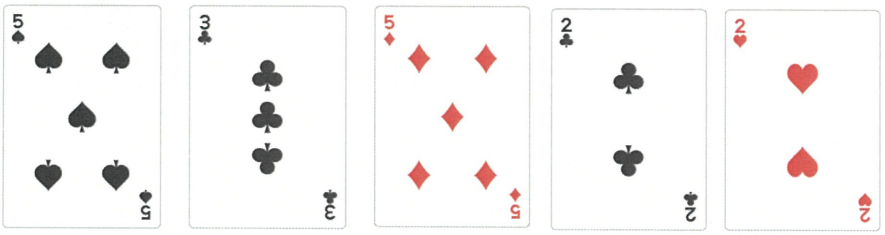
Rules

① Choose a number.
② Take two cards from the top of the stoack.
③ Make the number ① by calculating the numbers written on the cards you have taken.
④ If nobody can do it, take one more card from the top.
⑤ Repeat ③ and ④, and the person who makes the number ① first is the winner.

Notes

・The order of the number doesn't matter.

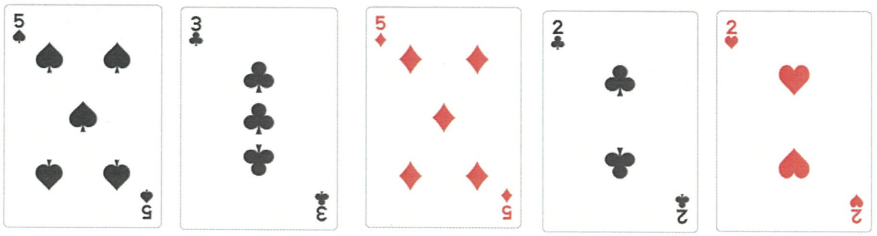
Ex.)



→ (5 + 5) × (3 + 2) ×2 = 100 OK!

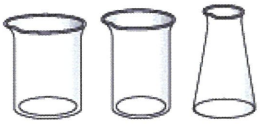
・Don't change the numbers.

Ex.)



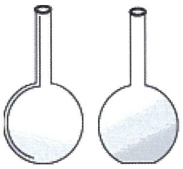
→ 25 × (5 + 2 − 3) = 100 NO!

□beaker



□test tube

□flask

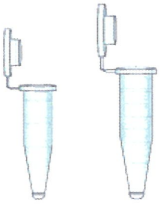


□measuring cylinder

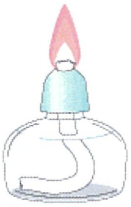
□funnel

□burette

□micro tube



□alcohol lamp



□measuring pipette

□whole pipette

□pasteur pipette

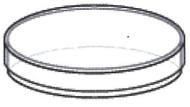
□micro pipette

□electronic scales

□centrifuge

□binocular microscope

□petri dish



What equipment do you use ?

Q.1

When you weigh powder — electronic scales

Q.2

When you filter water — funnel

Q.3

When you observe microbe — binocular microscope

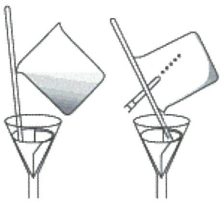
Q.4

When you warm liquid in test tube — alcohol lamp

How to use this equipment ?

Q.1

Filtration



Let's Draw!

Q.2

Distillation

Q.3

Water replacement method

◦ length (長さ)

×1/10 ⇦ ×100 ⇨ ×1000 ⇨

1 mm → 1 cm → 1 m → 1 km

[ミリメートル] [センチメートル] [メートル] [キロメートル]

◦ weight (重さ)

×1/1000 ⇦ ×1000 ⇨ ×1000 ⇨

1 mg → 1 g → 1 kg → 1 t

[ミリグラム] [グラム] [キログラム] [トン]

◦ area (面積)

×1/100 ⇦ ×10000 ⇨ ×1000000 ⇨

1 mm^2 → 1 cm^2 → 1 m^2 → 1 km^2

[平方ミリメートル] [平方センチメートル] [平方メートル] [平方キロメートル]

100 m^2=1 a 10000 m^2=1 ha

[アール] [ヘクタール]

◦ volume (容積)

×1/100　×1/10　×1000

⇦　⇦　⇨

1 ml → 1 dl → 1 l → 1 kl

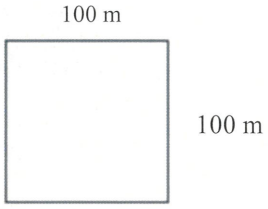
[ミリリットル]　[デシリットル]　[リットル]　[キロリットル]

Quiz

Q1　5 cm + 3 mm = ___ mm

Q2　100 40 kg boys weigh how many tons?

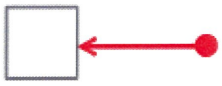
Q3　Find the area of the square on the left.



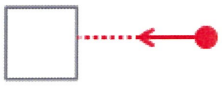
Q4　6703 ml = ___ l ___ dl ___ ml

Prepositions have each image such as moving or state. If you know their image, you can guess a mean that shows. Let's check 24 prepositions and try quizzes on next page.

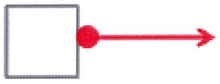
① to
"reach the goal"



② for
"don't reach the goal"



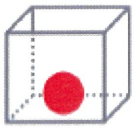
③ from
"leave the goal"



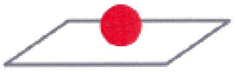
④ up
"go higher than point"

⑤ down
"go lower than point"

⑥ in
"be inside of space"

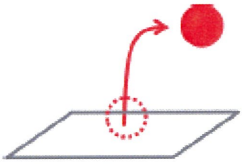


⑦ on
"touch the plane"

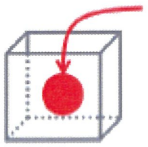


⑧ at
"one point"

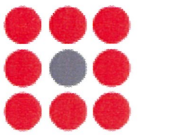
⑨ off
"leave the original point"



⑩ into
"enter the space"

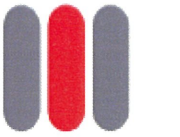


⑪ around
"surround"



⑫ among
"be surrounded"

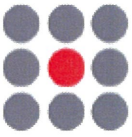
⑬ between
"be sandwiched"



⑭ of
"belong to something"

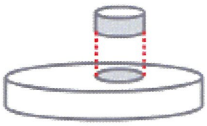
⑮ over
"go to the other side"

⑯ above
"be higher than standard"

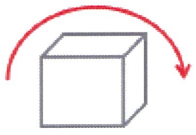


⑰ below
"be lower than standard"

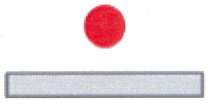
⑱ under
"be lower than thing"



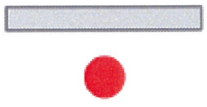
⑲ through
"advance space or time"



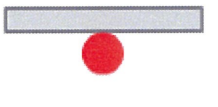
⑳ across
"cross plane"



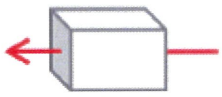
㉑ along
"parallel to slender thing"



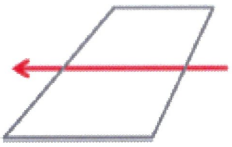
㉒ near
"be not far point"

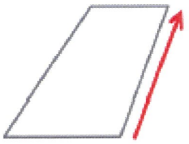


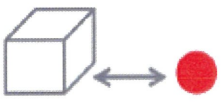
㉓ by
"have distance to target"

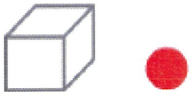


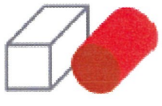
㉔ beside
"line up to target"











Quiz Time!

Look at the pictures and put the correct preposition in the blank.

(1) If you leave them lying ☐ the desk they may roll off, so stand them ☐ the test-tube rack.

(机の上に寝かせて置くと転がって落ちることがあるので、試験管立てに立てておく。)

(2) A fly flew ☐ to my desk and stopped on top.

(私の机の上にハエが飛んできって止また。)

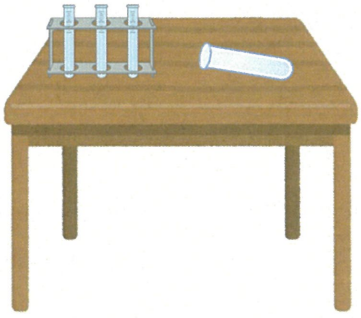
(3) Looking ☐ a microscope is very interesting.

(顕微鏡で見ることはすごく面白い。)

(4) Put Euglena ☐ yogurt.

(ミドリムシをヨーグルトの中に入れる。)

↓(1)



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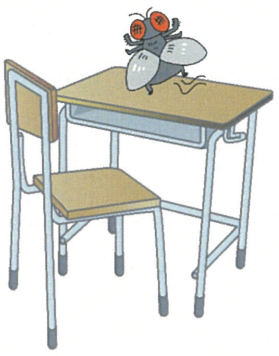


↓(3)

↓(4)

Answer

(1) on, in (2) over (3) through (4) into

a. 形式科学 —— Formal science

数学—— Mathematics

数学基礎論
—— Foundation of mathematics
数論—— Arithmetic
代数学—— Algebra
解析学—— Analysis
幾何学—— Geometry
離散数学—— Discrete mathematics
確率論—— Probability theory
応用数学—— Applied Mathematics
統計学—— Statistics

b. 自然科学—— Natural science

物理学—— Physics

力学—— Mechanics
電磁気学—— Electromagnetism
相対性理論—— Theory of relativity
原子物理学—— Atomic physics
素粒子物理学—— Particle physics
プラズマ物理学—— Plasma physics
天体物理学—— Astrophysics
物性物理学
—— Condensed matter physics
分子物理学—— Molecular physics

天文学—— Astronomy

地球科学—— Geoscience
地質学—— Geology
地球物理学—— Geophysics
自然地理学—— Physical geography
惑星科学—— Planetary science

生物学—— Biology

微生物学—— Microbiology
植物学—— Botany
動物学—— Zoology
自然人類学
—— Biological anthropology
古生物学—— Paleontology
分類学—— Taxonomy
進化発生生物学
— Evolutionary developmental biology
解剖学—— Anatomy
発生生物学—— Developmental biology
生態学—— Ecology
生物地理学—— Biogeography
分子生物学—— Molecular biology
遺伝学—— Genetics
生理学—— Physiology
神経学—— Neurology
生物物理学—— Biophysics

化学——Chemistry

物理化学—— Physical chemistry
有機化学—— Organic chemistry
無機化学—— Inorganic chemistry
分析化学—— Analytical chemistry
高分子化学—— Polymer chemistry
生化学—— Biochemistry
合成化学—— Synthetic chemistry
理論化学—— Theoretical chemistry

医学—— Medical science

薬学—— Pharmacy

歯学—— Dentistry

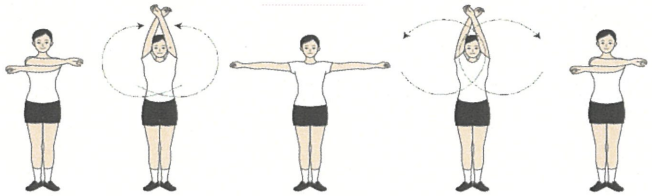
Movement: Radio Calisthenics

"Radio calisthenics" means "*Radio Taiso*" in Japanese. It was established in 1928 for the purpose of improvement for Japanese citizen's health and physical fitness. These days, it is hold by local communities all over Japan using radio cassette recorders and CD instead of a radio broadcast. Children who have joined it would get a stamp on their attendance card and they would be given some rewards such as stationery like pencils. Radio Calisthenics include 13 exercises in about 3 minutes.

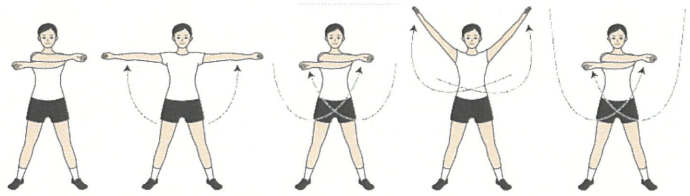
https://www.rajiotaiso.jp/common/image/logo_S.png

1. Rotate and stretch your arms

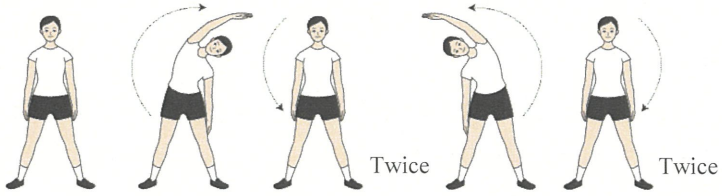
2. Cross and spread your arms while bending your legs up and down



3. Rotate your arms

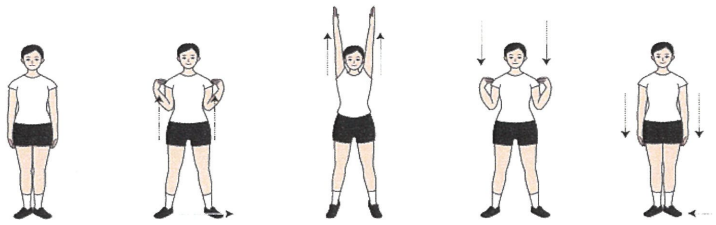


4. Lean backwards (chest out)

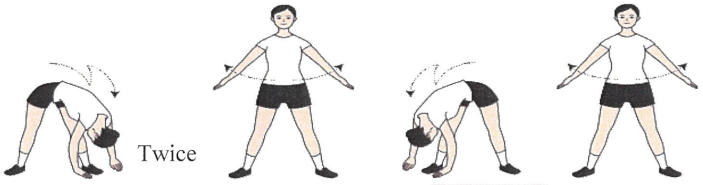


5. Twist your body sideways

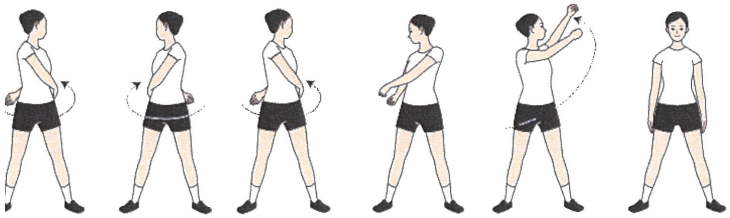
6. Bend your body back and forth



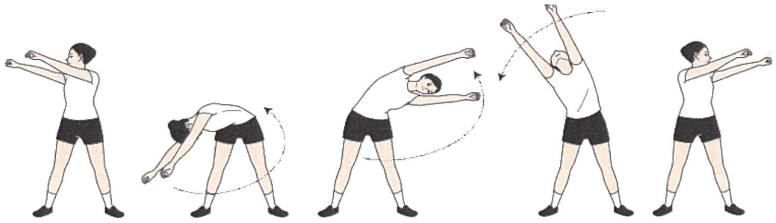
7. Twist your body from left



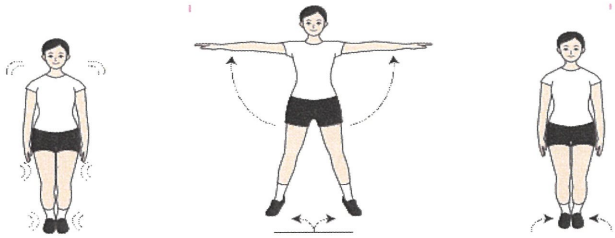
8. Stretch your arms up and down



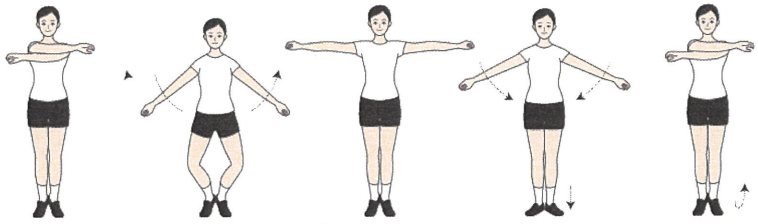
9. Bend your body diagonally downwards and chest out



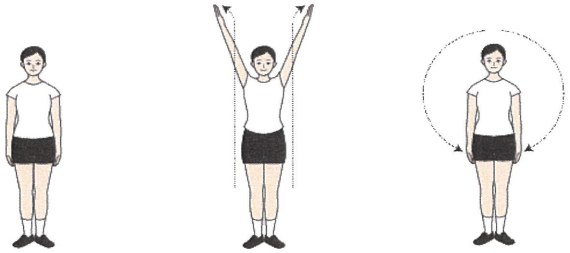
10. Rotate your whole body



11. Jump with both legs



12. Spread your arms then bend and stretch your legs



13. Breathe deep while stretching both arms (slowly)

Let's dance to music!

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	Ln	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	An	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fi	115 Mc	116 Lv	117 Ts	118 Og
	Ln		57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Tb	71 Lu
	An		89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Hydrogen　Alkali metals　Alkali earth metals　Rare earth elements

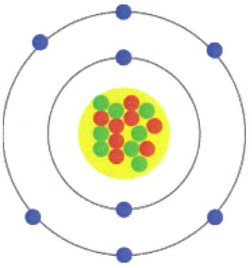
Actinoids　d-block elements　Boron group　Carbon group

Pnictogens　Chalcogens　Halogens　Noble gases

Other

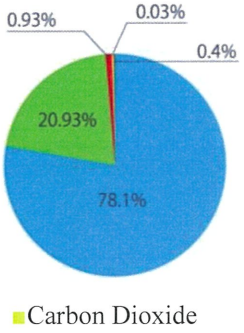
Let's change to Japanese!

- Electron (　　)　Proton (　　)
- Nucleus (　　)　Neutron (　　)



Question

Fill in the blank. ※Choices may be used twice.



■Q1 _____

■Q2 _____

■Q3 _____

Q4 _____

Q5_____

Q6_____

Q7_____

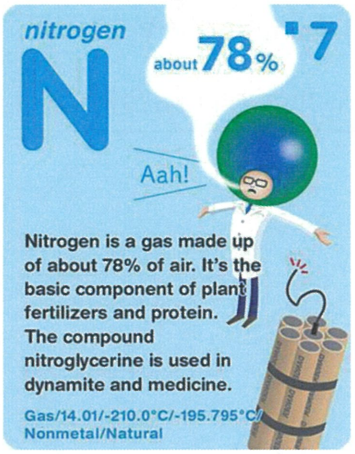
Q8_____ Q9_____ Q10_____

Q11_____ Q12_____ Q13_____

Aluminum / Argon / Carbon / Copper
Gold / Nickel / Nitrogen / Oxygen
Phosphorus / Silver / Strontium

Answer

Q1. Nitrogen



Nitrogen 窒素/fertilizers 肥料/protein タンパク質

nitroglycerine ニトログリセリン(爆薬の一種)

Practice

Nitrogen,

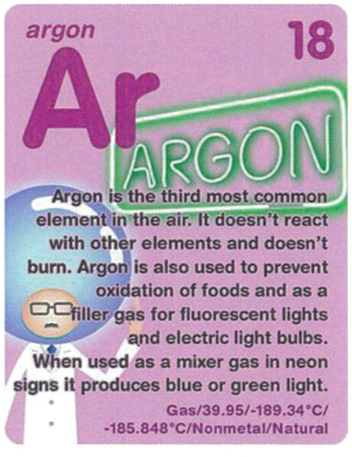
Q2. Oxygen

Oxygen 酸素/breathing 呼吸/rusting 錆/combustion 燃焼

Practice

Oxygen,

Q3. Argon

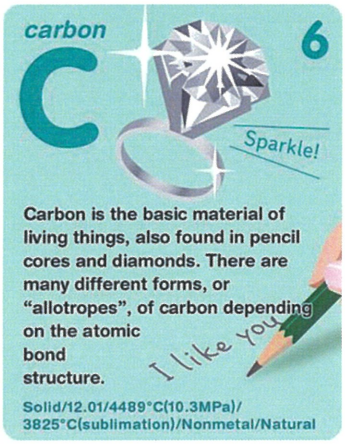


Argon アルゴン/oxidation 酸化/fluorescent 蛍光灯

Practice

Argon,

Q4.Q9. Carbon



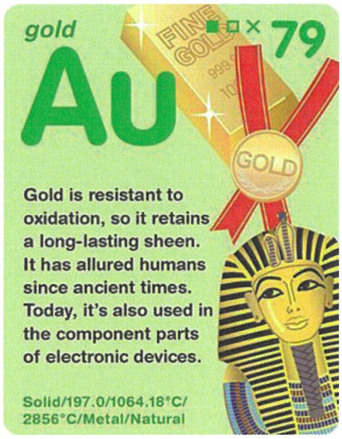
Carbon 炭素/pencil cores 鉛筆の芯/diamonds ダイヤモンド

Allotropes 同素体/the atomic bond structure 原子結合構造

Practice

Carbon,

Q5. Gold

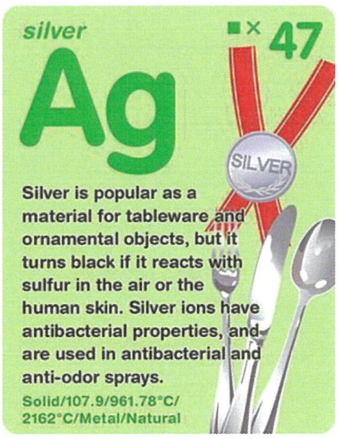


Gold 金/resistant 抵抗力/long-lasting 長持ちする

Practice

Gold,

Q6. Silver



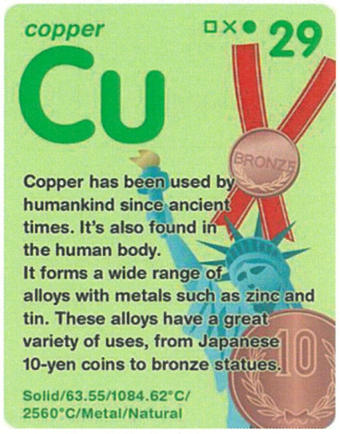
Silver 銀/tableware 食器/ornamental objects 装飾品

Sulfur 硫黄/antibacterial 抗菌/anti-odor 防臭

Practice

Silver,

Q7. Q12. Copper

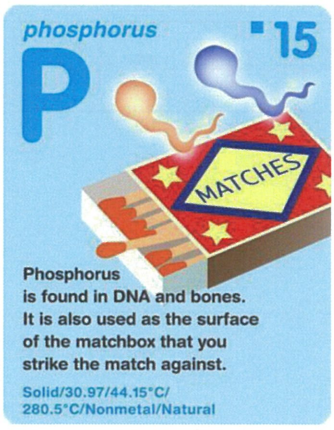


Copper 銅/humankind 人類/alloys 合金/zinc 亜鉛/tin 錫

Practice

Copper,

Q8. Phosphorus



Phosphorus リン/surface 表面/matchbox マッチ

Practice

Phosphorus,

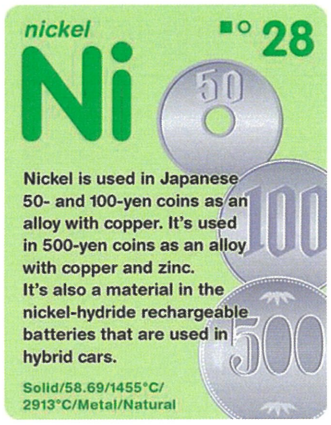
Q10. Strontium

Strontium ストロンチウム/fire works 花火

Practice

Strontium,

Q11.Nickel



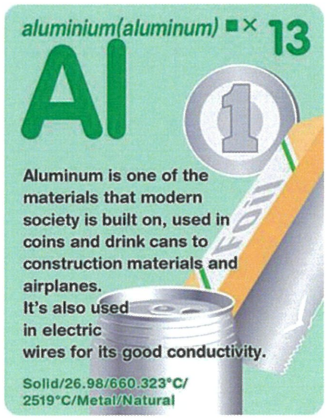
Nickel ニッケル/nickel-hydride ニッケル水素

rechargeable batteries 電池/hybrid car ハイブリッド車

Practice

Nickel,

Q13.Aluminum



Aluminum アルミニウム/airplanes 飛行機/electric wires 電線

Practice

Aluminum,

◎Weather phenomenon

○Cloud

上層雲	high cloud	CH	巻雲	cirrus	
			巻積雲	cirrocumulus	
			巻層雲	cirrostratus	
中層雲	middle cloud	CM	高積雲	altocumulus	
			高層雲	altostratus	
			乱層雲	nimbostratus	
下層雲	low cloud	CL	層雲	stratus	
			層積雲	stratocumulus	
			積雲	cumulus	
			積乱雲	cumulonimbus	

○Air pressure

高気圧	anticyclone
低気圧	cyclone

○Weather front

寒冷前線	cold front	停滞前線	stationary front
温暖前線	warm front	閉塞前線	occluded front

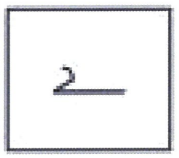
○Weather

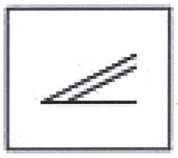
熱い	hot	湿度が高い	humid	寒い	cold
暖かい	warm	涼しい	cool	乾燥した	dry
蒸し暑い	muggy	肌寒い	chilly	風が強い	windy

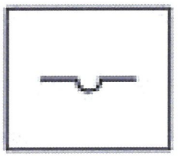
快晴	clear	霧雨	drizzle	雪	snow
晴れ	fine	嵐	storm	雹	hail
曇り	overcast	霧	fog	雷	thunderbolt
雨	rain	煙霧	haze	台風	typhoon

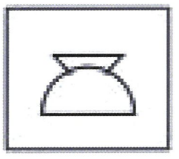
○Quiz

1. What clouds do these symbols mean?

①  (　　)

②  (　　)

③  (　　)

④  (　　)

2. Answer these questions.

① Which weather front has heavier rain, cold front or warm front?

② What does occur in downdrafts?

3. Fill in the blanks to match the Japanese.

① Today is (　　), but a little (　　).

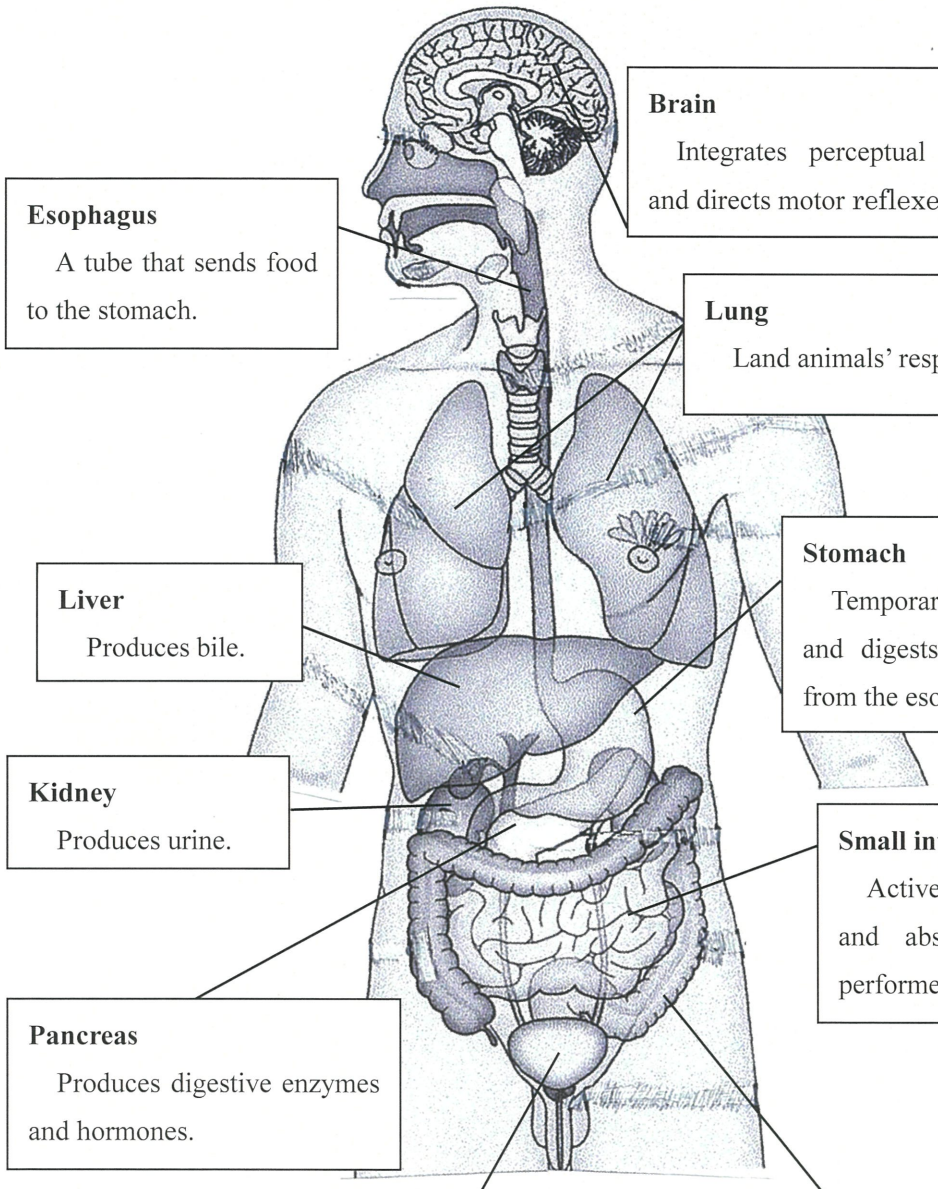
(今日は涼しいが、少し風が強い)

② "I'm sorry today because of (　　)." "Cheer up. It'll be (　　) tomorrow."

(「今日は雨で残念だ。」「元気出して。明日は晴れるよ。」)

○Answer

1. ① cirrocumulus ② nimbostratus ③ stratocumulus ④ cumulonimbus
2. ① cold front ② cyclone
3. ① cool/windy ② rain/fine



Brain
Integrates perceptual information and directs motor reflexes.

Esophagus
A tube that sends food to the stomach.

Lung
Land animals' respiratory organs.

Stomach
Temporarily stores and digests food sent from the esophagus.

Liver
Produces bile.

Kidney
Produces urine.

Small intestine
Active digestions and absorption are performed.

Pancreas
Produces digestive enzymes and hormones.

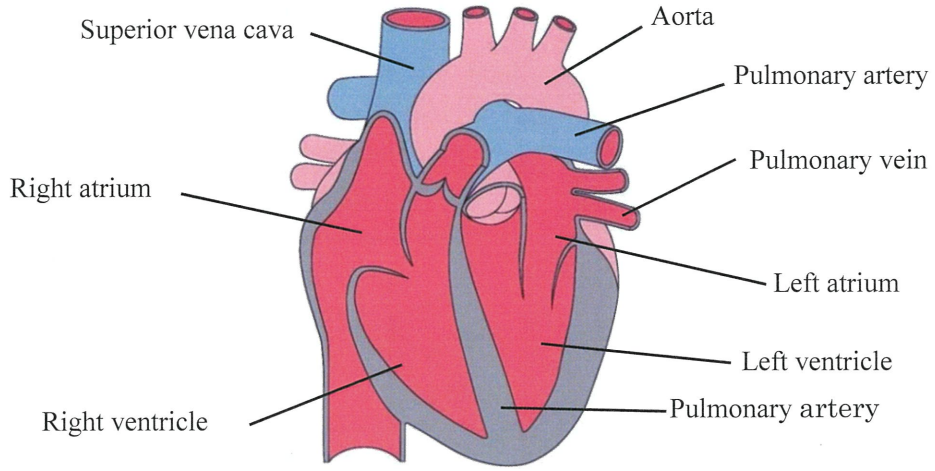
Colon
Water absorption and excretion storage.

Bladder
Collects urine.

Other

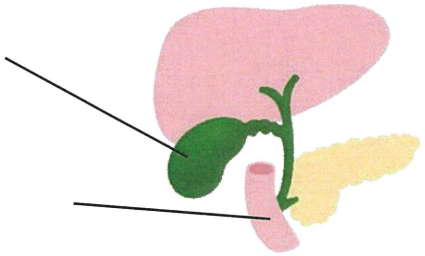
・Heart

Acts as a pump to pump blood.



・Gall bladder

Accumulates bile until needed for digestion.
Not present in all mammals.



・Duodenum

Gastrointestinal tract connecting the stomach and the small intestine.

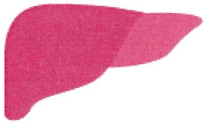
Quiz

Give the name and functions of the following organs:

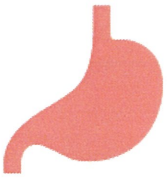
①

②

③

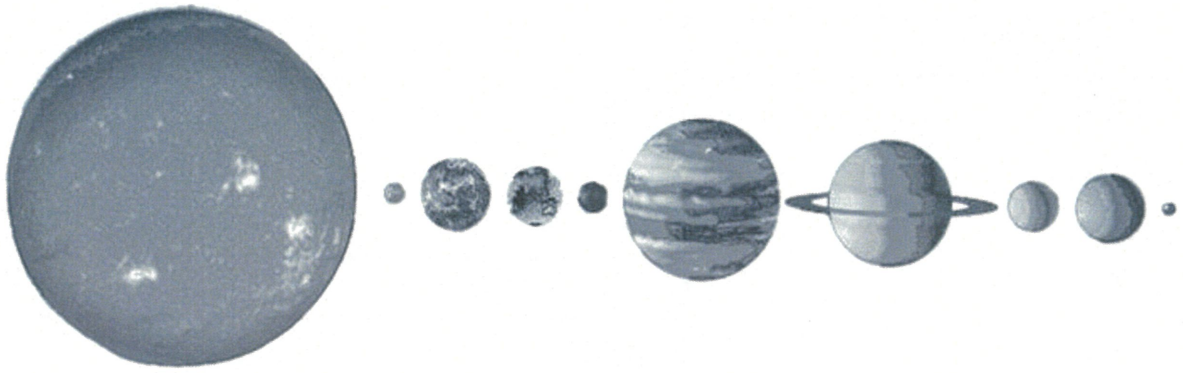


④



Correct answer ① Brain ② Lung ③ Liver ④ Stomach

《The Solar System》



SUN EARTH

< way to memorize >

My Very Educated Mother Just Served Us Nine Pizzas.

PUN	NAME	Origin
My	M	The guardian deity of merchants and travelers「mercurius」
Very	V	Goddess of beauty and love「venus」
Educated	E	"ground" in Latin「Tellus」「Terra」
Mother	M	God of battle and agriculture「mars」
Just	J	God「jupiter」
Served	S	God of agriculture「saturnus」
Us	U	Heavenly god wearing the universe「ouranos」
Nine	N	God who controls water in general「neptunus」
Pizzas	P	God of the underworld「pluto」

＊These are all gods from Roman mythology.

pun：語呂合わせ

Word list

〔天体用語〕			
太陽系	the solar system	軌道	orbit
銀河系	galaxy	光年	light year
恒星	fixed star	星座	constellation
衛星	satellite	〔代表的な星々〕	
小惑星	asteroid	北極星	the Pole Star
彗星	comet	北斗七星	（U.S.）the Big Dipper
超新星	supernova		（U.K.）the Plough
自転	rotation	南十字星	the Southern Cross
自転する	rotate	すばる	the Pleiades
公転	revolution	天の川	the Milky Way
公転する	revolve	シリウス	Sirius

You can use the internet !

Quiz

① What is the rotation cycle of Venus?

② How many satellites on Saturn?

③ What is the surface temperature of Mercury?

④ What is the distance between the sun and the earth?

⑤ When was the solar system born?

Answer ① 243 years ② 82 ③ 90 K～170 K ④ 150 million km ⑤ 46 billion years ago

CNN News

Reference:
https://www.cnnee.jp/index.php

CNNee

【Geoscience】

New Warning on Rising Sea Levels

New research warns that 150 million people living in coastal areas around the world could be submerged by rising seawaters in the next 30 years. That is a major increase from previous estimates. The findings come from Climate Central. Their report, based on new data, finds more than 70 percent of people living in vulnerable areas are in eight Asian countries, that is, China, Bangladesh, India, Vietnam, Indonesia, Thailand, the Philippines and Japan.

(73 words)

Rectangular Iceberg in Antarctica

And now to an unusual discovery from Antarctica. Now, NASA cameras involved in the decade-long IceBridge survey captured this, a nearly perfect rectangular-shaped iceberg. Now, the pictures are a hit on social media, with some people doubting anything like this could occur in nature. (44 words)

Star Destroyed by Black Hole

For the first time ever, scientists have watched a giant black hole rip apart what could be called an unlucky star. Scientists on Earth saw it as they watched via infrared telescopes and radio waves. This is how an artist rendered the event. It took a decade to play out. Nearly 150 million light years from Earth, the black hole, 20 million times more massive than the sun, stretched the star into a disk of dusty material. Wow. Half of the star was gobbled up by the black hole. The other half was spit out. (95 words)

Closer Look at Jupiter's Giant Storm

From 9,000 kilometers away. The Juno spacecraft left Earth in 2011 and has been orbiting Jupiter for just over a year now. Well, the storm's clouds are 16,000 kilometers wide. Wind speeds are up to 600 kilometers an hour. Well, NASA says scientists still don't know why the storm is red. Experts say understanding Jupiter's weather patterns could help us better understand Earth's own weather system. (66 words)

2016 Warmest on Record

We are just one day away from the inauguration of an American president who has expressed skepticism about global warming. But the scientific evidence continues to mount, and experts now say last year was officially the planet's warmest on record. It was the third straight year of record heating. Scientists say that burning of fossil fuels and destroying rainforests are part of the problem. (64 words)

CNNee

【Biology】

Monkeys Tested with Human Genes

An experiment being compared to the sci-fi classic Planet of the Apes has split the scientific community. It involves a Chinese researcher who implanted human genes into the brains of monkeys to study how human intelligence evolved. His team found that the modified monkeys did better on a memory test involving colors and block pictures, their brains took longer to develop, and no difference in brain size was found. Western scientists call the study reckless and very risky. (78 words)

HIV Patient Said to Be Cured

Some scientists say that a second person in history has been cured of HIV. A patient in London has been in remission for 18 months after treatment involving stem-cell transplants. The cells were taken from donors who have rare genetic mutations that make them resistant to HIV. This case comes more than 10 years after a Berlin patient was similarly cured by stem-cell therapy. (64 words)

Alarming Report on Vanishing Insects

The world is truly under threat, scientists say, from a catastrophic collapse of nature's ecosystems. Now, this is according to a new, global, scientific review of insects. This report, published in the Biological Conservation journal, finds the total mass of insects around the world is falling 2.5 percent every single year. At that rate, scientists say, all insects could vanish within 100 years. That's even though they're a crucial part of our ecosystems, including food for creatures such as birds, reptiles and fish. (83 words)

Giraffes at Risk of Extinction

The gentle giants of the African savanna, giraffes, are facing a silent extinction. The International Union for the Conservation of Nature says the giraffe population has plunged by nearly 40 percent in the past three decades. Now, the preservation group is putting giraffes on its "vulnerable" list, which indicates the species is at a high risk of extinction. The IUCN says habitat loss, illegal hunting and civil unrest are largely to blame for the decline in giraffe populations. (78 words)

Plan to Close Komodo to Tourists

Well, Indonesia is shutting down one of its most popular tourist destinations in a move to protect endangered Komodo dragons. Home to the largest lizards on Earth, the famed Komodo Island plans to close to visitors for a year. That's according to local media. It comes after smugglers were arrested. Authorities believe they stole 41 dragons from the island and sold them internationally. Each can fetch about $35,000 or more. (70 words)

CNNee

【Medical】

Medical Marijuana Approved in Thailand

Thailand has approved the use of medical marijuana. Thai lawmakers voted overwhelmingly for the amendment. One senator said getting it passed was like "a New Year's gift." Recreational use of marijuana is still illegal. Thailand is the first country in Southeast Asia to allow the use of medical marijuana. The region has some of the world's strictest drug laws.

(59 words)

Smoking-Related Deaths in China

A new study reveals just how deadly cigarette smoking is for men in China. The report, published in *The British Medical Journal*, says nearly two-thirds of young Chinese men will pick up the habit and, unless they stop, half of them will die of it. The study also found smoking deaths in China are set to triple to 3 million a year by 2050. It says China now consumes a third of all the world's cigarettes. And while scientists have found cigarette use is on the rise for Chinese men, it has fallen for women. (95 words)

Youth at Risk of Hearing Loss

The World Health Organization estimates more than 1 billion young people between the ages of 12 and 35 years old are at risk for losing their hearing. The cause: listening to audio devices or going to concerts and bars for too long with decibels at unsafe levels. The WHO recommends limiting the amount of time you listen to music to about one hour a day and not spending more than eight hours at events above 85 decibels to avoid permanent hearing damage. Most concerts hit more than 100 decibels. (89 words)

Ebola Outbreak, One Year On

It has been a year since the West African Ebola outbreak was first confirmed. This time, the virus has killed more than 10,000 people. But as you can see from this graph, the crisis seems to be heading toward containment. The number of new cases, shown by the colored lines there, has dropped since December. However, governments are not ready to declare the crisis over. Sierra Leone's president is calling for a zero-Ebola campaign. The goal here is to reach zero infections in 60 days. (85 words)

Birth from Uterus from Deceased Donor

All right, turning now to a medical first at a hospital in Brazil. For the first time, a baby was born to a woman who received a uterus transplant from a deceased donor. The details are laid out in a new study published in the medical journal *The Lancet*, and the recipient had been born without a uterus. Doctors say the organ was not rejected and she delivered via C-section. In less than two weeks, the baby will be celebrating her first birthday. (83 words)

CNNee

【Technology】

High-tech Implant for The Brain

SpaceX founder Elon Musk's latest vision for the future is a way to merge your brain with artificial intelligence. Musk is cofounder of Neuralink, a start-up which aims to implant a device in the brain that would communicate with an iPhone app and computers as well. Musk says the device could be used to improve memory, repair motor function or just help people with cognitive defects. He says the trials could begin by the end of next year. Critics, though, are warning about the risks of business enterprises gaining access to brain data. (93 words)

Apple Unveils Recycle Robot

Sunday is Earth Day, and Apple is doing its part with a major recycling initiative. The company has unveiled a new robot named Daisy which can take apart 200 iPhones an hour to recover valuable materials. Apple will make a donation to the nonprofit group Conservation International for every device turned in for recycling at one of its stores or through Apple.com. Customers can also earn credit for eligible devices. The Apple GiveBack program ends April the 30th. (78 words)

A Robot That Can Do Backflips

We want to leave you with this impressive leap in robotics development. Just watch as Boston Dynamics' Atlas robot skillfully jumps around these elevated blocks and then does a perfect backflip. This is an incredible feat, as humanoid robots are very tricky to balance. Look at that. Boston Dynamics is known for its slightly strange-looking but very well-balanced robots. And besides backflips, some can do household chores like bringing you a drink or loading the dishwasher. (76 words)

5G Network Launched in China

China has now switched on the world's largest 5G network. And with it, wireless customers are expecting to get service so lightning fast it will leave our current 4G service in its dust. The US, South Korea and other countries already have 5G in certain places, but China is trying to get the edge. (54 words)

Quadriplegic Uses Limbs Tech to Walk

A man who lost the use of all four limbs in a fall four years ago—well, he's been able to walk and move his limbs again. He's known only as Thibault. He's been working with virtual simulators and an exoskeleton for two years. He's now walked 145 meters, and he can reach for targets with his arms. Researchers did this: they implanted a recording device in his head that translates brain signals into movements of the suit. (78 words)

CNNee

【Space】

NASA's First All-Female Spacewalk

NASA is conducting, right now, its first all-female spacewalk. They are repairing some broken equipment outside the International Space Station. The first all-female spacewalk was supposed to have taken place back in March, but it was canceled, because there weren't enough size-medium spacesuits ready for the walk. And by the way, NASA is working on a new, more flexible spacesuits that will fit both men and women. (67 words)

Potentially Habitable Planet Found

For the first time, scientists say they've found a relatively nearby planet with water and temperatures that could potentially support life as we know it. Researchers using data from the Hubble Space Telescope say they detected water vapor in the planet's atmosphere and it's warm enough for liquid water to ow there. The so-called super-Earth is several times larger than our planet, and it orbits its red sun every 33 days. (71 words)

First Pic of Black Hole

Researchers with the National Science Foundation say a supermassive black hole is more than a Muse song. They say they captured a picture of one and that this is the first direct visual evidence that black holes exist. To capture what they say is an image of one, scientists synced up a global network of telescopes in 2017, and they all zoomed in on a spot in the universe that's estimated to be 55 million light years away from Earth. (80 words)

Repeating Radio Burst from Space

Far outside our Milky Way galaxy, about 1.5 billion light years away from Earth, these short bursts of radio waves are being recorded—first in 2015, the second one in the summer of 2018. These millisecond-long radio -ashes are not rare in space, but this is only the second one that has been found to repeat, and both came from the same location. The mystery about why the bursts happen and where they come from—now, that goes on. (79 words)

CIA Released The X-Files

All right, so, we end the show with talk of alien life. You're probably either a believer or a skeptic, much like the agents Mulder and Scully on that hit TV show The X-Files. Now, you can help the U.S. government solve real-life investigations into possible extraterrestrial sightings. The CIA has released hundreds of declassified documents on aliens. You can find the cases on the blog of the Central Intelligence Agency, and perhaps, now, the truth is actually out there. (80 words)

CNNee

【Social Media】

Facebook Aims for Better News

Mark Zuckerberg is determined to use Facebook as a platform for global unity. He just released a lengthy manifesto on Facebook's mission, and in it, he addresses the criticism about the spread of fake news on Facebook and admits the site is now a major source of news. He says Facebook will work on creating inclusive and informed communities. And to do that, he outlined plans to use artificial intelligence to crack down on terrorist propaganda, and to promote diverse views on news feeds. He also points out a strong news industry is critical in building an informed community, saying that Facebook needs to do more to support it.

(109 words)

Games Build Immunity to fake News

In this era of fake news, with memes, tweets and other kinds of posts, being able to recognize fact from fiction is a skill worth having. But to do that, one needs to practice and learn how to spot phony information. So researchers at Cambridge University have developed an online game called Bad News that helps you think like a troll. The goal: vaccinate people against bogus news. (68 words)

Twitter Doubled Character Limit

Twitter is a major part of how many of us communicate online. But let's face it—it is tough to sum up international policy, complicated news stories, even your feelings about Game of Thrones, in just 140 characters. So Twitter is now doubling the character limit. The expanded character count will be tested by people who tweet in English, Spanish and Portuguese. That's because the same information in some languages takes up more characters than in others.

(77 words)

No More MS Paint?

A familiar icon will soon be vanishing from Windows computers. The extremely basic drawing tool MS Paint could be gone in one of the upcoming Windows 10 fall updates. Now, Paint is far from a sophisticated image editor and is known for its, yes, cartoonish flat colors. But the news is sparking a huge wave of nostalgia. Users are tweeting out Paint artwork tributes, like this one saying, "RIP"—rest in peace—"MS Paint. RIP our childhoods."

(77 words)

Facebook Bans Guns Sale

Facebook has announced it is banning private gun sales on all of its platforms, including social-media site Instagram. The company already prohibits users from selling illegal drugs but says it is hoping to crack down now on peer-to-peer weapon sales. Licensed firearm retailers will still be able to post about their goods only as long as all transactions take place off-site. Facebook says any content that violates its new policy will be removed. (73 words)

Reports

Synthesis of Biodegradable Plastic Made from Starch

Airi NOJIRI　Ryo MURAKAMI　Rina KUSABA

Abstract

We researched making biodegradable plastics using starch. The purpose of this study is to clarify the appropriate condition by which they are made and to make a practical plastic from starch.

Key words: starch, plastic, acetic acid, acetic anhydride

Introduction

In recent years, soil and water pollution due to plastic has become a serious environmental issue. To help solve this issue, biodegradable plastics have been produced, which are decomposed by microorganisms into natural substances such as water and carbon dioxide. Biodegradable plastics are currently made from corn and other grains, which are used as surplus crops. Due to deforestation in some areas for the sake of producing biofuels, it cannot be said that the situation has improved. Last year, we succeeded in synthesizing plastics from three types of starch through acetic acid esterification. We performed this research in order to clarify the appropriate conditions to synthesize the biodegradable plastics.

1. Examine whether we can synthesize plastics from four types of starch: dogtooth violet starch, corn starch, kudzu flour, and sweet potato starch, under various conditions (heated temperature, heated time, and amount of water)
2. Examine usability of the plastics in terms of thermoplasticity, strength, and expandability

Materials and Methods

Experiments

1. Synthesis of biodegradable plastic by esterification with acetic acid to synthesis biodegradable plastic from starch
2. Experiment using a spectrophotometer to examine whether the starch is esterified and to clarify why water heated at 80°C became transparent
3. Synthesis of biodegradable plastic by acetylation with acetic anhydride to find differences between acetic anhydride and acetic acid in the same experiments
4. Verification of thermoplasticity and expandability to examine whether we can use the plastics in practice

Details of the experiments

1. Dehydration condensation of acetic acid molecule to hydroxy group in starch molecule (Figure 1, 2)

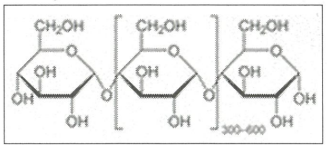


Figure 1 Starch molecule.

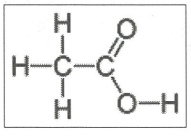


Figure 2 Acetic acid molecule.

2. Make a graph of absorbance using a spectrophotometer
   →When changes in the graph are observed, the starch could be esterified.
3. Acetylation of starch molecules with acetic anhydride (Figure 3).
4. Put on a hot plate and examine themoplasticity molecule.
   Put in water for 5 mins and examine the mass change.
   Use two types of starch: kudzu flour and sweet potato starch.

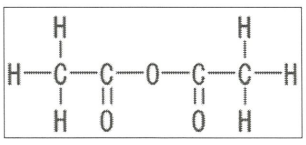


Figure 3 Acetic anhydride.

Methods

1. In Figures 4,5,6,7,
   (1) Prepare 2 g of starch, 2 ml of distilled water, and 2 ml of acetic acid ×4 (A)

Prepare 2 g of starch, 1 ml of distilled water, and 2 ml of acetic acid ×2 (B)

(2) Add a few drops of concentrated sulfuric acid, and heat at a suitable temperature for 5 min (A×2 and B×2)

Add a few drops of concentrated sulfuric acid, and heat at 80°C for 5 min(A×2)

(3) Neutralize with aqueous sodium bicarbonate and wash with distilled water a little after cooling to the appropriate temperature

2. In figures 8,9,
   (1) Prepare (A) and heat at suitable temperature or 80°C
   (2) Prepare an aqueous starch solution as a control group
   (3) Measurement the absorbance of each group
3. In figures 10,11,12,13,
   (1) Prepare (A)×2 and heat at 80°C for 5 min
   (2) Neutralize with aqueous sodium bicarbonate after cooling to the appropriate temperature
   (3) Consider the difference between acetic acid and acetic anhydride
4. In figures 14, 15,16, and table 1,
   (1) Put on a hot plate and heat at 160°C for 5 min or 10 min
   (2) Put the plastic in a beaker for 5 min and check the change

Results and Discussion

1.

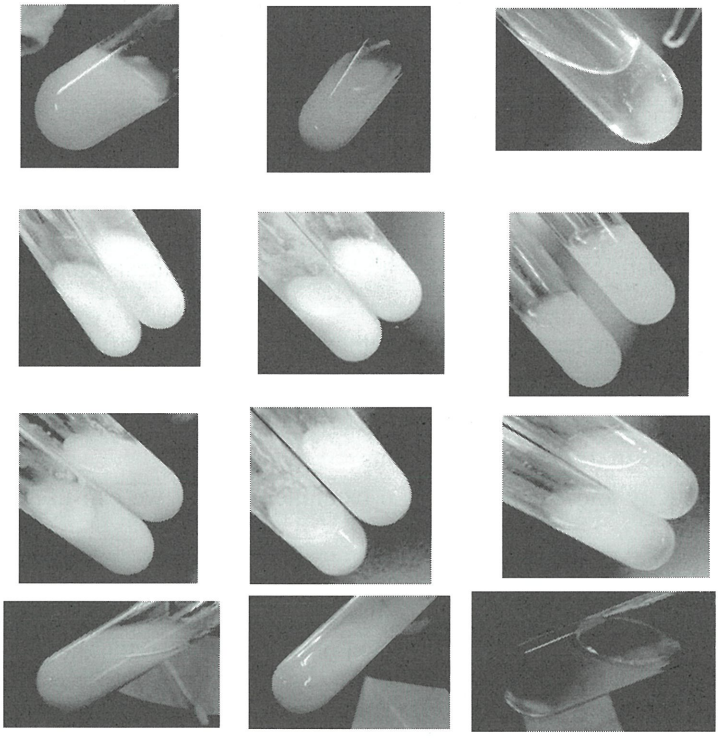


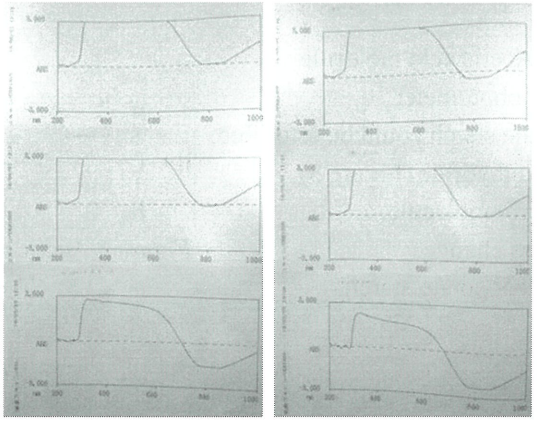
Figure 4 Dogtooth violet starch.
(Left) (A) heating at suitable temperature
(Middle) (B) heating at suitable temperature
(Right) (A) heating at 80°C

Figure 5
Corn starch.

Figure 6
Kudzu flour.

Figure 7
Sweet potato starch.

2.



(Top) Aqueous starch solution

(Middle) Heating at suitable temperature

(Bottom) Heating at 80°C

Figure 8 Corn starch. *Figure 9* Kudzu flour.

3.

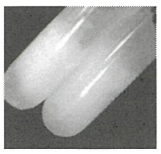


Figure 10 Dogtooth violet starch.

Figure 11 Corn starch.

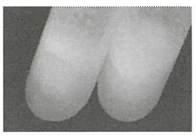


Figure 12 Kudzu flour.

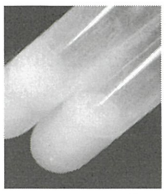


Figure 13 Sweet potato starch.

4.

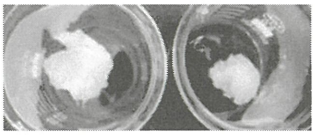


Figure 14 Pre-heated.

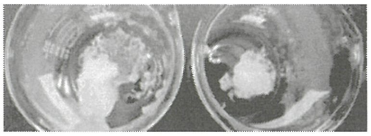


Figure 15 Heated for 5 min.

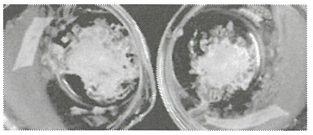


Figure 16 Heated for 10 min.

Table 1 *Expansion*

Expansion	Pre	Post
Kudzu flour	1.167 g	1,233 g
Sweet potato starch	1.348 g	1.453 g

Discussion

1. No type of starch solidified as a liquid. All four types of starch became slightly transparent after heating at 80°C compared to the gelatinization temperature (Figures 4-7). We concluded that using acetic acid is not good for making plastic.
2. As the top and middle graphs are similar in shape, the substances do not change after heating at a suitable temperature. On the other hand, the bottom graph has a different shape, so we found changes in the substance after heating at 80°C (Figures 8, 9).
3. The substances did not solidify with acetic acid, but solidified with acetic anhydride. Substances with acetic acid became transparent, and substances with acetic anhydride became cloudy white (Figures 10-13). We could not take out the substances with dogtooth violet starch and corn starch well. Substances with kudzu flour and sweet potato starch, on the other hand, did solidify well, so we could take them out easily. In summary, kudzu flour and sweet potato starch is better to synthesize biodegradable plastic by esterification with acetic anhydride.
4. The substances gradually became softer and easier to deform when prodded with a glass stick (Figures 14-16). We concluded that these substances may be considered thermoplastic. Mass increased slightly. However, after immersion in water for 5 min, we forgot to wipe droplets off the plastic surface. The substances did not appear to expand significantly.

Conclusion

Using kudzu flour or sweet potato starch with acetic anhydride heated at 80°C provides the best conditions. These plastics may be practical plastics, so we could find the appropriate condition. However, we could not clarify why we should synthesize plastics at this time. Additionally, we could not get accurate results in verification of expandability or make various shaped plastics for practical use, so we intend to think about them.

References

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  https://doi.org/10.1271/kagakutoseibutsu1962.33.159
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- Tokyo Chemical Industry Co, Ltd.
  https://www.tcichemicals.com
- Hitachi High-Technologies Corporation
  https://www.hitachi-hightech.com/hhs/products/tech/ana/uv/basic/

Acknowledgments

We are grateful to Mr. Katsuhito Minami, graduate students, and teachers for their assistance in this study.

Water Purification Using Natto

～Principle of Purification and Neutralizer Specification～

Kotaro KANAZAWA Yuki INOUE Yuki ITO

Abstract

Elucidate a system for cleaning polluted water using γ-PGA, a material extracted from *natto* (a type of food made from fermented soybeans). We investigate the best neutralizer to add with γ-PGA to change sewage water into clean water. We study how to change sewage water into clean water using an everyday material in our lives.

Key words: γ-PGA, Neutralizer, Purification, Sewage

Introduction

Polyglutamic acid (following γ-PGA) has the ability to collect dirty particles in sewage and precipate them. γ-PGA is the constituent material of mucin in natto. In our research, we extract γ-PGA from natto and use it in our experiment. According to previous research from last year, when γ-PGA is added to sewage and water purification occurs, we found it only purified water a little. Thus, we put together a hypothesis called "The principle of water purification". This is based on procedures we have done in the past. In addition, we add neutralizer to sewage with negative charges to neutralize it before we add γ-PGA. In this year's research, we attempted to prove this hypothesis and identify the optimal material to use as neutralizer.

In the previous research, we used soil from the athletic field at our school as the sewage. This year, in addition, we used water from a pond at the house of one of our researchers. Also, we put sewage into 500 ml plastic bottles for the experiment, but we changed 500 ml plastic bottles to 300 ml beakers. When we say the sewage was purified, we checked the transparency of the sewage through last year, and when the sediment settles after purification and we can judge the sediment to be obviously bigger than particles such as mud. Upon meeting these conditions, we define water purification as having occurred.

Materials and Methods

Experiment 1

We put 200 ml of sewage (pond water and muddy water) in the 300 ml beaker, and we also prepared γ-PGA extracted from natto and a neutralizer ($Ca(OH)_2$). Additionally, we prepared a stirrer to stir the sewage. In this experiment, we want to find whether the principle of water purification is correct, and we can use the purifying function of γ-PGA clearly from previous research. In our research, we experiment with two patterns of water purification experiments one, adding both (neutralizer and γ-PGA) to sewage, and secondly, adding only γ-PGA to sewage.

This is the procedure for experiment 1.

(1) Add $Ca(OH)_2$ 0.2 g to the beaker containing 200 ml of sewage
(2) Add 0.1 g γ-PGA
(3) Stir firmly with a stirrer for five minutes.
(4) After five minutes, stop stirring and leave it for three minutes.
(5) After three minutes, take notes and take a picture of the appearance of the beaker.
(6) This cycle is 1 set. Do the experiment adding both and adding only γ-PGA repeatedly.

Experiment 2

According to previous research, we found it was possible to purify sewage water with certainty when the neutralizer is $Ca(OH)_2$, and we anticipate that $Ca(OH)_2$ plays a role in helping the work of γ-PGA. Therefore, we prepared two material groups (One is cation unified Ca^{2+}, the other is anion unified OH^-). Graph 3 references the materials used:

Table 1 Used Materials

Cation = Ca^{2+}	Anion = OH^-
$Ca(OH)_2$	$Ca(OH)_2$
$CaCl_2$	NaOH
CaO	$Al(OH)_3$
$Ca(NO_3)_2$	$Zn(OH)_2$

We do the same cycle in experiment 2 (experiment 1 reference). In experiment 1, various kinds of materials are used as neutralizers. For each material, we perform the water purification experiment six times and check the results.

Results and Discussion

In this year's research, we did two types of research, as mentioned above. First, we prove the hypothesis (Graph 1 reference) the principle of water purification (experiment 1). This includes adding the procedure of adding neutralizer into sewage before adding γ-PGA, as with previous procedures. According to previous research, we know γ-PGA has a purifying function and we only checked for the presence of the necessity of neutralizer to prove our hypothesis. Therefore, we made use of calcium hydroxide (following $Ca(OH)_2$) as a neutralizer when we succeeded in purifying sewage. We also check the cases of experiments adding both (neutralizer and γ-PGA) and only γ-PGA.

Three evaluation criteria in purifying "the sewage":

(1) The evaluation water became transparent after the experiment.
(2) The residual water became transparent after the experiment.
(3) The size of sediment mass is visible.
(Distinguishing them after settling due to passing of time)

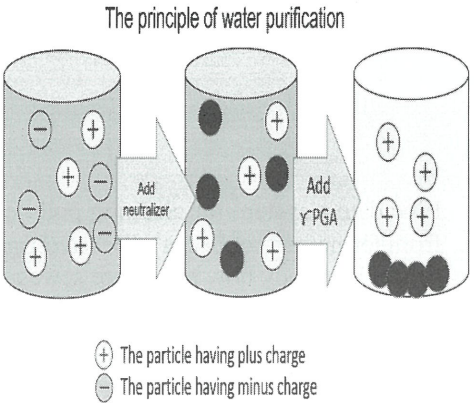

Figure 1 Materials Used.

We check whether water purification occurs when we use what materials as neutralizers based on the results of experiment 1 (experiment 2). According to previous research, we experimented with purification and then we used different materials as neutralizers (calcium hydroxide, calcium chloride, sodium hydroxide, sodium chloride, aluminum hydroxide, aluminum chloride). When the neutralizer is calcium hydroxide, water purification occurred with certainty, with calcium chloride, a majority of the bottles checked were purified. For the others, we have never checked water purification in 10 times experiments for each material. Based on the results, we determine that the materials that play a role in helping γ-PGA work because of Ca^{2+} and OH^- are the materials in $Ca(OH)_2$ that enable to happen water purification at a high level as a neutralizer. We prepared two groups. One is cation Ca^{2+}, the other is anion OH^- and we experiment with water purification based on the principle of water purification using each material as a neutralizer. Afterwards, we analyzed the results.

Table 2

Materials	Results
Calcium hydroxide $Ca(OH)_2$	◎
Calcium chloride $CaCla_2$	○
Sodium hydroxide Na (OH) 2	×
Sodium chloride $NaCl_2$	×
Aluminum hydroxide $Al(OH)_3$	×
Aluminum chloride $AlCl_3$	×

Results and Discussion

Experiment 1

According to the results of experiments performed more than 20 times (reference photo graph 4). We found the results of water purification based on the principle we created are overwhelmingly clean compared with the others. We found that the former's masses were greater than the latter, and rose to the level of transparency with certainty before the experiment.

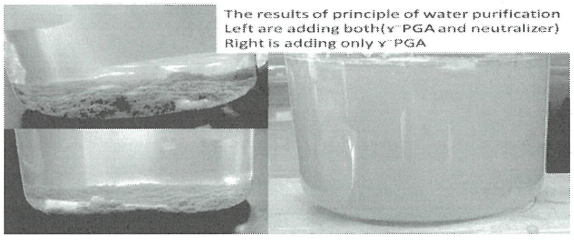

Figure2 The results of the principal of water purification

Experiment 2

According to the results of experiments performed six times for each material (graph 5, 6, 7) the materials we used to check the water purification in sewage were $Ca(OH)_2$, $CaCl_2$, CaO, and $Ca(NO_3)_2$. Looking at the groups all of the group's materials in which cation unified Ca^{2+} were checked for water purification more than five times for each material. On the other hand, the group's materials in which anion unified OH^- were only $Ca(OH)_2$ was checked for water purification.

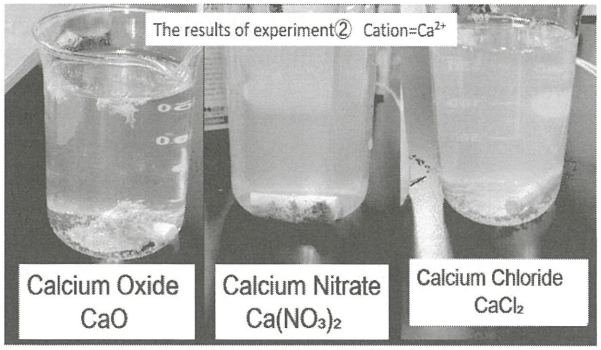

Figure 3 The results of experiment 2.1

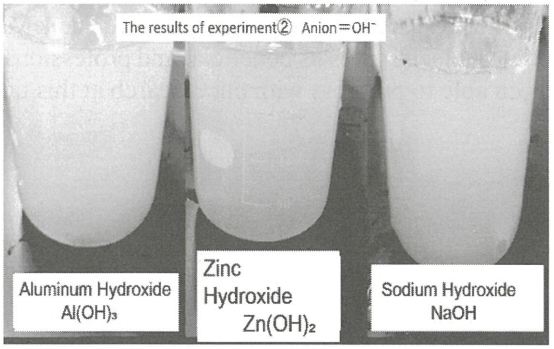

Figure 4 The results of experiment 2.2

Conclusion

Experiment 2

We checked whether the neutralizer needs to promote γ^-PGA working as water purification. We concluded that when we add neutralizer to sewage too water purification occurs clearly, so the principle of water purification is correct and when we add only γ^-PGA, it so low, so we think neutralizer has the ability to neutralize the negative charge of particles in sewage and promote working of γ^-PGA.

The results of experiments for each materials

Cation=Ca^{2+}	Results	Anion=OH^-	Results
$Ca(OH)_2$	◎	$Ca(OH)_2$	◎
$Ca(NO_3)_2$	○	$Na(OH)_2$	△
CaO	◎	$Al(OH)_3$	×
$CaCl_2$	○	$Zn(OH)_2$	×

Figure 5 The results experiment 2 for each materials

Experiment 2

According to the results of experiment 2, all of the groups containing Ca^{2+} were checked for purification, so it is thought that Ca^{2+} is involved with water purification. Also, among the group containing OH^-, $Ca(OH)_2$ succeeded in purifying water and contains Ca^{2+}. This is why, in water purification, it is believed that the material that promotes the working of γ^-PGA is Ca^{2+}. Including previous research (graph 2) and considering ions, whenever the material cation contained Ca^{2+}, water purification in sewage has occurred. (Depending on the kind of material, the level of results will change)

At present, our sewage consists of pond water and muddy water. Thus, the sewage includes metal ions generally classified as sewage. We use this and check water purification occurring according to our principle of water purification. In the future, we should take in turbidity meter, etc. to judge the success of removing metal ions from sewage in water purification. Additionally, in this research we use pure powder in the chemical room as a neutralizer, but our purpose is to use substances around ourselves and purify sewage to make clean water, so we need to change the neutralizer to something easily accessible around us such as rocks, plants, or waste.

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Ackowledgements

In doing this research, for about one year, we thank Mr. Minami, who is in charge of the SSH chemical room. When we have trouble, he gives us beneficial and professional advice to solve our problems. Without his help, we wouldn't have been able to progress with our research at this time. Thank you very much.

The Condition in Which a Crystal of Pyramid-Shaped Salt Precipitates

Hirokazu SUNAIKE　Akari KIMURA　Rikuto HIRATE

Abstract

Ptolemy salt is a crystal of a pyramid-shaped salt. It forms when you add other materials to a salt solution. We did research into the relationship between Ptolemy salt and liquidity. It was revealed that the liquid characteristics had to be a less-than-constant pH, and then surface tension work at the surface to form generations of the Ptolemy salt.

Keywords: Ptolemy salt, sodium chloride, added material, hydroxide ion, pH, surface tension

1. Introduction

In Salar de Uyuni, hollow pyramid-shaped crystals called Ptolemy salt are deposited. However, the formation principles and conditions of these crystals have not been clarified in detail. In previous studies, when various substances were added, Ptolemy salts precipitated, but Ptolemy salt did not precipitate when only sodium hydroxide was added. This study reveals the conditions for a substance to affect pyramidal-shaped salt from the nature of sodium hydroxide.

2. Introduction

In salt lakes with extremely high salt concentrations, such as in the Uyuni salt flats, crystals of sodium chloride may grow in special pyramid shapes. Ptolemy salt precipitates when cubic salt crystals forming on the water surface grow horizontally and vertically on the liquid surface. In this study, a crystal with an apex cube and a hollow inside with a step on the surface is defined as Ptolemy salt (see Figure 1). Even if just one of the above crystal precipitates, it is treated in the experiment that Ptolemy salt appeared.

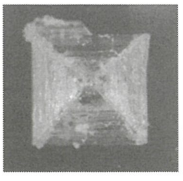


Figure1 Ptolemy salt

When recrystallizing sodium chloride, by changing the conditions in the liquid the shape changes in order to the crystal becoming as stable as possible. It is believed that Ptolemy salt appears when sodium chloride precipitated on the liquid surface sinks little by little and crystals adhere to the periphery. It is known from the literature that trivalent metal ions (such as aluminum ions) easily precipitate when added. To date, it is revealed that Ptolemy salt appears when adding other substances containing metal ions (such as potassium chloride and copper sulfate), substances that do not contain metal ions (such as hydrochloric acid and nitric acid), and substances that do not ionize (such as soluble starch). However, a common feature of the added materials that precipitate these Ptolemy salts are that the acidity in the solution is neutral or acidic, and the crystals have sufficiently grown on the liquid surface. Only when adding the sodium hydroxide, which releases hydroxide ions, was it unable to make Ptolemy salt. Furthermore, sodium hydroxide has a

function of lowering the surface tension of the liquid surface as a surfactant.

In this study, we focused on two points: "pH in the liquid" and "surface tension of the liquid surface," and observed the conditions for forming Ptolemy salt.

3. Materials and Methods

Prepare a saline solution obtained by adding 0.5 ml of NaCl to 5.0 ml of pure water.

a) Influence of hydroxide ions on Ptolemy salt formation

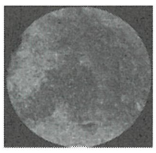
A substance containing hydroxide ions (a substance that ionizes and releases hydroxide ions) is added by 0.01 mol (Ex.1-1).

Alternatively, NaOH or KOH is used to make the solution basic, and the pH is measured in a solution in which 0.01 mol of kalium chloride (making Ptolemy salt at any time) is added as a material to make Ptolemy salt (Ex.1-2).

b) The effect of surface tension on Ptolemy salt growth

Add 0.01 mol of substance to reduce surface tension (insoluble oils, surfactants) or add these chemicals with 0.01 mol of kalium chloride. (Ex 2).

Solutions a) and b) are heated with a hot stirrer while keeping the temperature of the liquid surface constant. After the resulting crystals are sufficiently dried, they are observed using a microscope.



The figure below shows the design of the experiment (Figure 2).

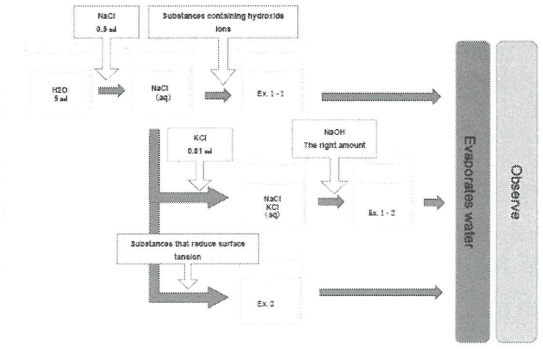


Figure 2 Experiment

4. Results and Discussion

[1] Effect of hydroxide ions on Ptolemy salt formation

Among substances containing hydroxide ions, there were substances that precipitated Ptolemy salt and those that did not (see Table 3 below). In addition, film on crystals (see Figure 4) in which sodium chloride grew in a horizontal direction (liquid level direction) was observed in solutions in which Ptolemy salt did not precipitate. Their effects increased as basic ions increased. The precipitation limit pH of Ptolemy salt was around pH10, although there was some error depending on the substance (See Figure 5 below). In addition, when the acidity in the solution became basic, the amount of precipitated Ptolemy salt rapidly decreased. (See Figure 6 below)

Table 3 comparative experiment

Substance	Acidity	Ptolemy salt
NaOH	Strong base	×
KOH	Strong base	×
Ca（OH）$_2$	Weak base	○
Al（OH）$_3$	Weak base	○
NH_3	Weak base	○

Figure 4 Filmed-shaped crystal with sodium

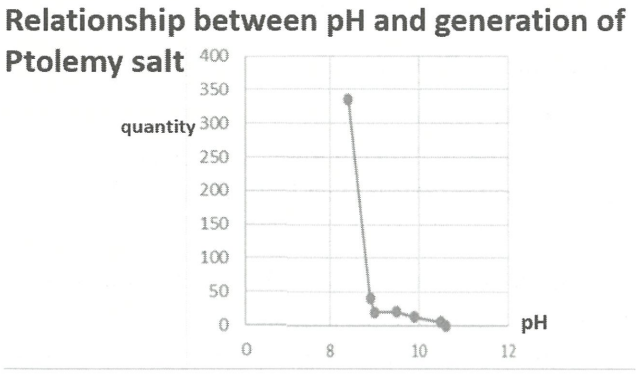
A) NaOH B) KOH

Appearing	Not appearing
appearing	Not appearing

p H:7 8 9 10 11 12 13

Figure 5 Relationship between pH and appearance of Ptolemy salt

Figure 6



The Uyuni salt flats in Bolivia are known to have Ptolemy salt that appears naturally. Around these salt flats, brine containing lithium salt is taken, meaning added material, which is one of the conditions for Ptolemy salt precipitation. What is more, the pH of the Uyuni salt flats is 6.3 to 6.9 (acid to neutral). From this, it is believed that, even naturally, Ptolemy salt precipitates relatively easily when the acidity is neutral or acidic (Quote: Published version of Mitsubishi Corporation 100308final.doc).

[2] Effect of surface tension on Ptolemy salt growth

It was found that some substances that could lower the surface tension could not generate Ptolemy salt. Alcohols precipitated Ptolemy salts, whereas insoluble oils (oleic acid) and surfactants (benzalkonium chloride), which can reduce surface tension, weren't able to make Ptolemy salt (See Table 7 below). These two materials that hinder constituting Ptolemy salt changed the nature of the solution, so not only was Ptolemy salt absent, regular salt was also absent. In both cases where the Ptolemy salt did not precipitate, the added substance floated on the liquid level and hindered the growth of salt crystals (See Figure. 8 and 9 below). Therefore, there is not enough reason to conclude that why the Ptolemy salt did not precipitate was that the substance reduced the surface tension. However, it is believed from these experiments that it is at least necessary that the state of the liquid surface be stable (there is no substance that directly hinders the growth of the crystal) and the crystal continues to float on the liquid surface (Table 7).

Substance	Characteristic	Ptolemy Salt	Added Kalium Choroid
Ethanol	alcohol	○	○
oleic acid	insoluble oil	×	×
benzalkonium choroid	surfactant	×	×

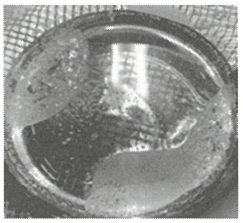


Figure 8
When oleic acid is added

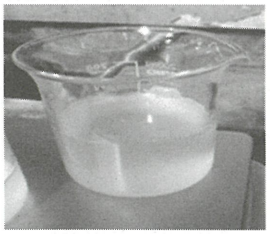


Figure 9
When benzalkonium choroid is added

Cause of white turbidity in solution of salt when adding benzalkonium chloride. When a large amount of ethanol was added (1 mol., which is equivalent to sodium chloride), the solution became cloudy (See Figure 10 below). When this sample was heated as in the other cases, no Ptolemy salt formed. Benzalkonium chloride and ethanol work to attract water molecules around themselves during hydration. It is believed that these substances deprived the chloride ions and sodium ions, which were hydrated with water, of water molecules as ions, thereby precipitating the sodium

chloride (because this action works quickly, a very small amount of salt precipitates in large quantities, so Ptolemy salt does not precipitate).

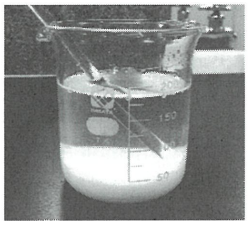


Figure 10 sodium chloride precipitation

5. Conclusion

It is observed that the reason why Sodium chloride formed a film-like structure when adding hydroxide ions was that the hydroxide ion changed the growth direction of the salt crystal (changed the crystal growth surface). Furthermore, since its action depends on the pH in the solution, it is believed that the Ptolemy salt appears relatively easily in an acidic or neutral solution. The reason that the Ptolemy salt grows in a pyramid shape is that the crystal that continues to float on the liquid surface grows in a certain direction (horizontally or vertically) and then partially restricts the crystal growth direction.

6. Development

[1]: Measuring the growth number of Ptolemy salt

In this study, we performed experiments on the precipitation conditions of Ptolemy salt by adjusting the pH by adding sodium hydroxide. However, sodium hydroxide is a strongly basic substance and is inconvenient for use under weakly basic conditions. Therefore, it is necessary to measure in more detail under weakly basic conditions data using a buffer solution or the like.

[2] Elucidation of reasons for growth surface inhibition by additives

It became clear that additives and liquid properties have some effect on the growth of Ptolemy salt in this study. However, it was not possible to clarify the reason why sodium chloride is influenced by these situations.

[3] Elucidation of conditions where Ptolemy salt is most likely to precipitate

In this study, the precipitation conditions of Ptolemy salt were observed by examining the environment where precipitation was most difficult. However, regarding Ptolemy salt precipitation, the frequency of precipitation was not measured. Therefore, by examining the environment that is most suitable for Ptolemy salt precipitation from the degree of precipitation, we believe that it can be applied to mass production of Ptolemy salt.

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8. Acknowledgements

I would like to thank Katsuhito Minami and Koji Kubono for their useful discussions. I am grateful to Katsuhito Minami for his assistance in the almost all of our experiments.

Elucidation of the Principle of Cola Milk

Haruka YAMAKI Airi SHIJO Moeka YOSHIDA

Abstract

When milk is added to cola, the cola will settle and become transparent. This phenomenon and its principles were investigated in detail. As a result of the following experiment, it was found that the cause of precipitation around pH 2.0 was considered to be the denaturation by acid, and the cause of precipitation around pH 4.0 was the isoelectric point of the protein casein, contained in milk.

Key words: Cola, Milk, precipitation, denaturation, protein, isoelectric point

Introduction

When milk is put in cola, precipitation occurs and it becomes transparent. It was hypothesized that acids such as carbonate and phosphoric acid in cola were able to denature and solidify casein contained in milk, causing precipitation. The only cola used in this experiment was Coca-Cola, of the Coca-Cola co., Ltd. company in Japan, and "Oishi Gyunyu" from Meiji Co., Ltd.

Materials and Methods

(1) Adding milk to carbonate and phosphoric acid

First, we experimented with carbonate and phosphoric acid. Carbonation was carried out twice using Seven-Eleven 'carbonated water,' and was also used to boil as a control experiment. Phosphoric acid was added at 0.01 mol, 0.02 mol, 0.05 mol, 0.10 mol and a carbonate concentration of twice these amounts, respectively. Phosphoric acid and milk was added by 1 ml, respectively. The temperature and pH of the liquid were measured before and after adding milk.

(2) Add milk to coke

The pH of the liquid was measured before and after adding milk. Milk was added by 1 to 9 mL coke, at 50 ml. Following explanations of (1) and (2) in the interim presentation, questions arose such as "It is gastric juice (hydrochloric acid) that originally digests milk? Why not experiment with it?" and "Can you precipitate with other carbonated drinks?" Experiments were conducted to address these questions.

(3) Adding milk to hydrochloric acid

0.001 mol, 0.002 mol, 0.005 mol, 0.010 mol, and 1 ml of milk were added to hydrochloric acid in concentration. The temperature and pH of the liquid were measured before adding milk.

(4) Adding milk to other carbonated beverages

Experiments were also carried out with other carbonated beverages in parallel with (3). 2 ml Milk was added to 50 ml of each beverage, placed in a beaker. In addition to Cola, Asahi Beverage Co., Ltd.'s Mitsuya Cider, Japan Coca-Cola Co., Ltd.'s Fanta Orange and THE TANSAN, and Calpis Soda from Calpis Co., Ltd. were used.

(1) Carbonic acid is removed, cooled
(2) Carbonic acid is removed, at room temperature
(3) With carbonic acid, cooled
(4) carbonated, at room temperature

The experiment was carried out in four conditions. The average temperature when cooled was 9.2 degrees C., the average temperature at room temperature was carried out at 17.6 degrees C.

Results and discussion

(1) Add milk to carbonic acid and phosphoric acid

○Carbonated

Although a small amount of precipitate formed even in the case of boiling, the result was that the amount of precipitate was clearly larger in the case of carbonic acid. The right figure is a photograph of the result. White precipitation can be visually observed at the bottom of the two carbonated beakers on the left (Figure 1).

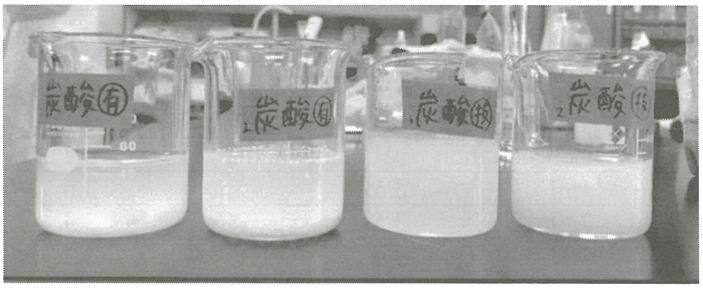

Figure 1 Carbonic acid precipitation.

○phosphoric acid

The next figure is a table showing the change in pH before and after adding milk to phosphoric acid

Table 1

Concentration	pH before addition	pH after addition	Status
0.01 mol/L	3.3	3.9	Formed
0.02 mol/L	3.2	3.6	Formed (most)
0.05 mol/L	3.1	3.4	Not formed
0.1 mol/L	3.1	3.3	Not formed

* This is the average of three experiments performed.

Phosphoric acid resulted in the highest precipitation around pH 3.63. The lower figure is a photograph of the results.
(Figure 2).

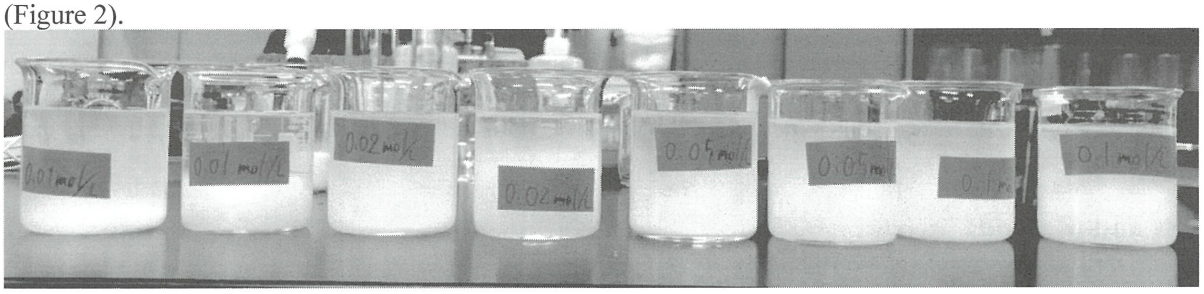

Figure 2 Phosphoric acid precipitation.

(2) Add milk to cola

Precipitation formed at all amounts, but the result was that the precipitation was the largest at around pH 4.5 (addition of 3, 4 ml) after addition. The figure below is the photograph (Figure 3).

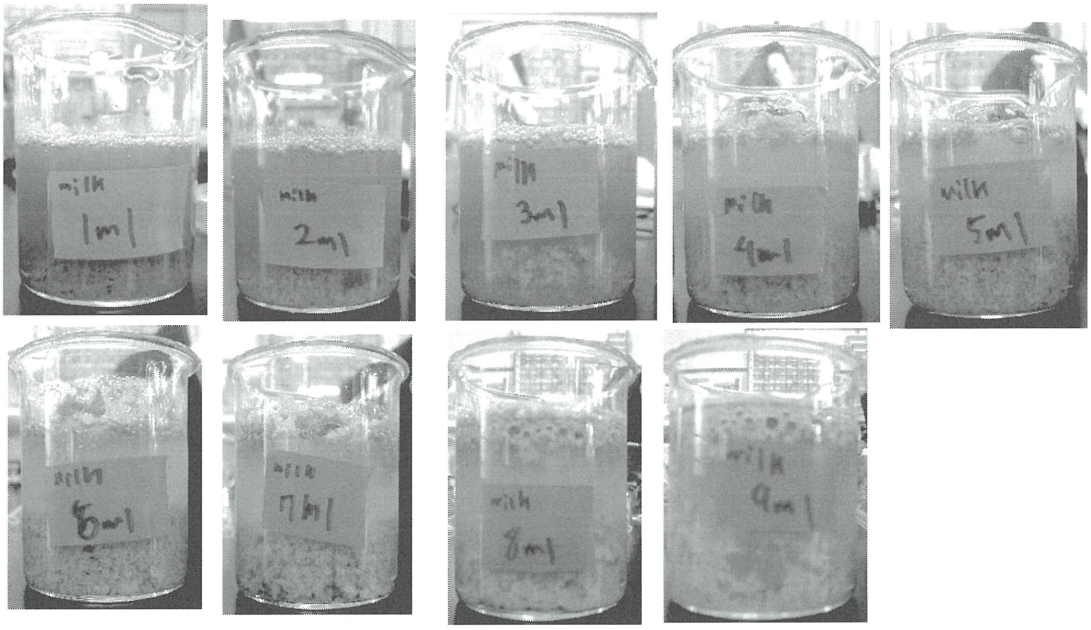

Figure 3 Precipitation in cola.

Table 2 The figure below shows the change in pH before and after the addition of milk by amount of addition

Concentration	pH before addition	pH after addition	Status
1ml	3.5	3.6	Little formed
2ml	3.5	3.9	Little formed
3ml	3.6	4.2	Formed (most)
4ml	3.5	4.6	Formed (most)
5ml	3.5	4.9	Little formed
6ml	3.5	5.1	Little formed
7ml	3.5	5.2	Little formed
8ml	Not measuring	5.3	Little formed
9ml	Not measuring	5.4	Little formed

(3) Add milk to hydrochloric acid

Hydrochloric acid had the highest precipitation, at pH 2.3. The lower figure is a table showing the change in pH before and after the addition of milk for each concentration, and photographs of the results (Table 3 and Figure 4)(Tested twice each for concentration and average).

Table 3

Concentration	pH before addition	pH after addition	Status
0.001 mol/L	2.8	3.0	Not formed
0.002 mol/L	2.6	3.5	Formed
0.005 mol/L	2.2	2.3	Formed (most)
0.01 mol/L	2.2	2.0	Formed

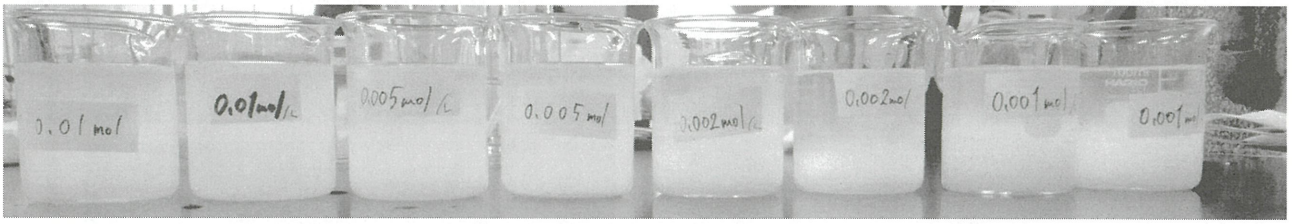

Figure 4 hydrochloric acid.

(4) Add milk to other beverages

Mitsuya Cider precipitated in all of ① to ④ and did not show a significant change in pH. The figure below is a table showing the changes in pH before and after the addition of milk for each condition (Table 4).

Table 4

Condition	pH before addition	pH after addition	Status
①2	4.0	4.0	Formed
②	3.9	3.9	Formed
③	4.0	4.1	Formed
④	3.8	3.8	Formed

Fanta orange precipitated in all of ①-④, and no significant change in pH was observed. Initially it was a white precipitate, but after two days the precipitate turned orange and the liquid became clear. The figure below shows changes in pH before and after the addition of milk for each condition (Table 5).

Table 5

Condition	pH before addition	pH after addition	Status
①	3.4	3.4	Formed
②	3.0	3.3	Formed
③	3.3	3.5	Formed
④	3.1	3.4	Formed

Calpis soda settled in all of ①-④, and no significant change was observed. The figure below is a table showing the changes before and after the addition of milk under each condition (Tab.6).

Table 6

Condition	pH before addition	pH after addition	Status
①	3.9	3.7	Formed
②	3.5	3.7	Formed
③	3.8	3.7	Formed
④	3.4	3.9	Formed

With THE TANSAN, precipitation occurred in ①, but did not occur in ② to ④, and there was a significant change in ① and ②(Table 7).

Table 7

Condition	pH before addition	pH after addition	Status
①	4.7	4.4	Formed
②	4.4	6.5	Not formed
③	4.5	4.1	Not formed
④	4.2	5.1	Not formed

The picture below shows the results of Mitsuya Cider, Fanta Orange, Calpis Soda, and THE TANSAN (Figure 5).

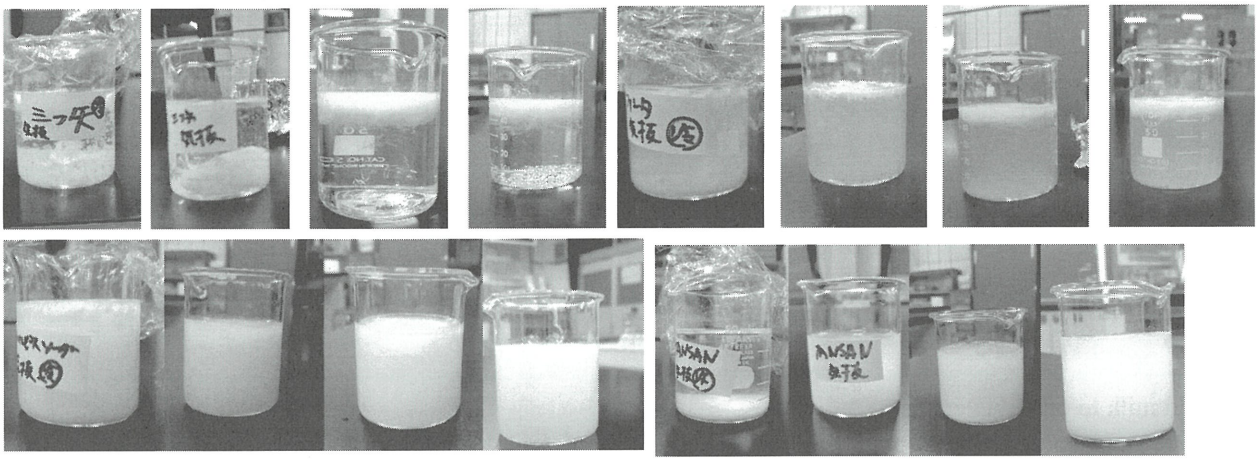

Figure 5 Precipitation in assorted carbonated beverages. Conditions ① to ④ are left to right.

From (1) to (3), precipitation was found to occur most often in the vicinity of PH2.2 to PH4.0. In the experiment, the isoelectric point of casein is pH4.6, and it is most likely to aggregate at that point. The isoelectric point is considered to be the cause of precipitation in the vicinity of pH 4.0. Precipitation near PH2.3 was our original hypothesis, thought to be due to acid coagulation. Further, from (4), it was found that precipitation also occurs in other types of carbonated beverages. However, it is necessary to take out the precipitation and examine it because it is not known whether precipitation occurs due to the same principles as cola. Whether or not carbonic acid is present, even if the temperature changes, because there is not much change in the amount of precipitation that can be visually confirmed, the presence or temperature of carbonic acid is not considered to be significantly involved in the process of precipitation.

Conclusion

It was found that Cola could coagulate and precipitate milk for two reasons: protein isoelectric point and acid denaturation. In these experiments, the amount of precipitation was confirmed only visually because it was not possible to take out precipitation efficiently. There were also many problems and timing mistakes when taking photographs. In the future, while looking for a way to solve the problem, it is necessary to examine the components of other carbonated beverages involved and look for commonalities with Coke.

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Acknowledgements

I was taught a lot of things by Mr.Minami, Mr.Fukuda, and other teachers.
I am grateful to them for their helpful infomation.

Improved Salt Tolerance of *Arabidopsis thaliana* with Ethanol

Ai KITANISHI　Mizuki KAGEYAMA　Riku NAKAMURA

Abstract

When seawater enters the soil after a tsunami, a phenomenon occurs called salt damage that makes it difficult for plants to grow. However, when ethanol is added, the increase in the salt tolerance allows *Arabidopsis thaliana* to grow. In this study, we studied detailed conditions for improving salt tolerance of *Arabidopsis thaliana* using ethanol by researching the survival rate. As a result, some characteristics of improving salt tolerance were found.

Key words: Salt damage, Active oxygen, Ascorbate peroxidase, Ethanol

Introduction

There are several reasons why plants may not grow due to salt stress, one of these being the generation of active oxygen. This refers to oxygen with particularly strong oxidizing power. In figure 1, when plants feel stress, they produce a great deal and accumulate it. Intracellular DNA is then damaged, causing cell death.

However, when ethanol is added, increasing the salt tolerance of the *Arabidopsis thaliana* allows it to grow in a salty environment. This is because ascorbate peroxidase and a group of genes that are capable of removing active oxygen are expressed. Removal of active oxygen prevents cell death and allows *Arabidopsis* to survive (Kaori Sako 2018).

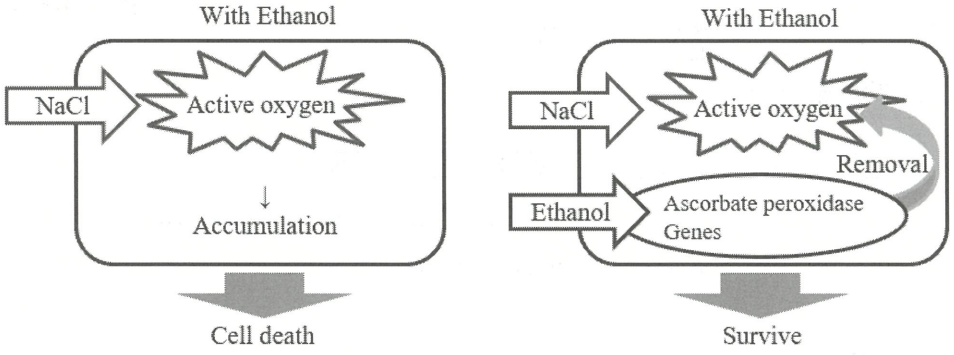

Figure 1 Principal of improved salt tolerance.

In this study, in order to understand more efficient uses of ethanol, we clarify detailed conditions necessary to improve salt tolerance. We focused on the amount and timing of ethanol, and investigated detailed conditions for developing salt tolerance.

Materials and Methods

We used the survival rate of *Arabidopsis thaliana* as an index for improving salt tolerance. The reasons for choosing this plant is that its growth is very fast and it was used in previous studies for model plants. Previous studies judged survival in their leaves as green or white at the time of measurement, but there are some that were a mix of both. Therefore, we observed whether the leaves were green, yellow or white (Figure 2), and calculated the survival rate for green and yellow individuals.

We considered salt tolerance as having improved if the subject showed a higher survival rate than without ethanol. We performed the following two experiments.

Figure 2
The state of *Arabidopsis* at the time of judgment. From left to right, green, yellow, white.

1. Changes in amount ethanol and survival rate

We placed 5 *Arabidopsis thaliana* seeds into 1 ml 1/2 medium and let it grow for four days. From these, we added 99.5% ethanol in amounts of 0%, 0.2%, 0.3%, 0.5%, 0.7%, 1%, 2%, 3%, 5%, 7%, 10%, and 15% to the medium, and 24 hours later, we added 20 μl 3% NaCl. Four days later, we examined the survival rate.

In the above-mentioned experimental method, the test subject with a rate of ethanol to medium of 0.3% was decided as the call "standard".

2. Survival rate when order timing is changed

We changed the timing of order and conducted experiments (Figure 3).

1 (Standard) …Control
2 …Switch the timing of adding NaCl and ethanol
3 …Add ethanol for 2 consecutive days, and NaCl next day
4 …Add NaCl and ethanol in the same day
5 …Start the experiment immediately upon planting
6 …Start the experiment after eight days' growth

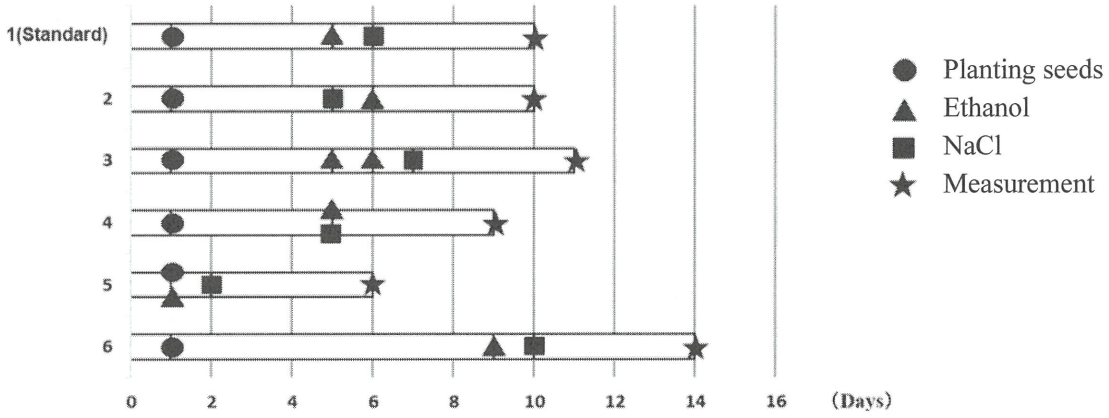

Figure 3 Operation timing.

In both experiments, we experimented with 30 grains (5 grains × 6 sets) for each condition. We used artificial weather equipment during growth and changed the environment every twelve hours. Daytime was set at 25 ° C with light, and night was set at 23 ° C without light.

Results and Discussion

1.

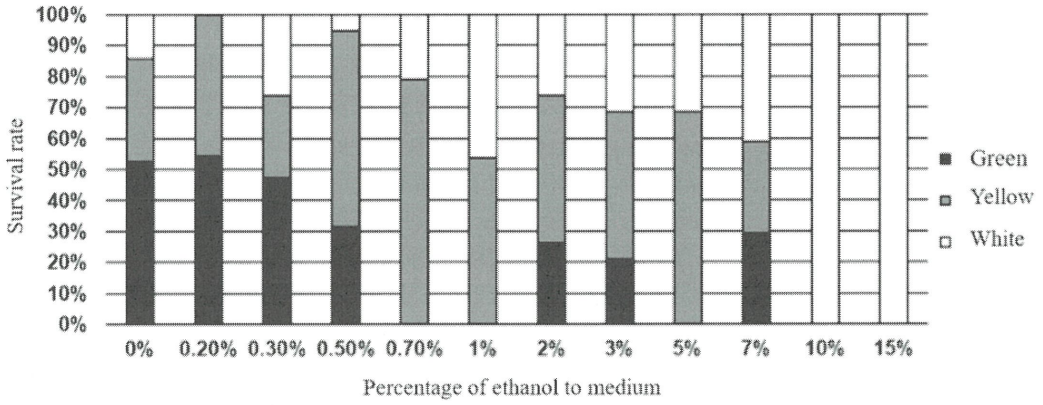

Figure 4 Changes in amount of ethanol and survival rate.

We examined changes in survival rate by amount of ethanol. When ethanol was given with 0.2% of the medium, the survival rate was high. However, the survival rate decreased as the amount of ethanol added increased. *Arabidopsis thaliana* grew to some extent even in an ethanol-free environment (Figure 4).

We measured influence on *Arabidopsis thaliana* by amount of ethanol. We judged that salt tolerance developed because the survival rate was high when ethanol was given a low rate of the medium at about 0.2%. It was observed that cell fixation took place and made the plants die because the survival rate decreased when too much ethanol was given.

2.

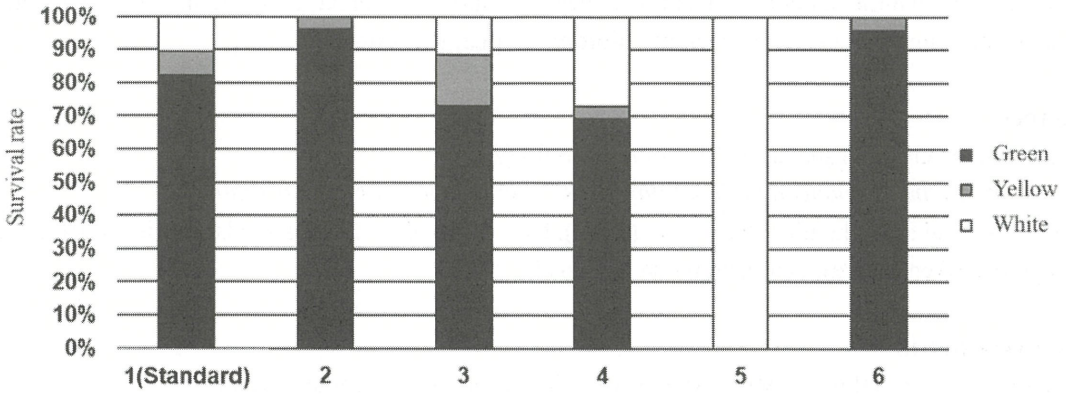

Figure 5 Survival rate when operation timing is changed.

The effect of operation timing on salt tolerance was investigated. The survival rate was high even if the timing of feeding ethanol and NaCl was reversed. However, simultaneous addition of NaCl and ethanol reduced the survival rate. The survival rate was low when experimenting with seeds, but the survival rate increased when the seeds were grown to some extent (Figure 5).

We then observed the characteristics of improved salt tolerance of *Arabidopsis thaliana* by changing the timing of operations. It is believed that the speed of production of active oxygen is no longer than the speed of expression of ascorbate peroxidase. If the generation rate of active oxygen was slow, ascorbate peroxidase lasted 24 hours from previous research, so it is thought that ascorbate peroxidase disappears before active oxygen is generated, and the survival rate decreases (Figure 6. -a). However, because the salt tolerance actually improved, the assumption that the production speed of active oxygen is slow is not plausible. Conversely, assuming that the expression of ascorbate peroxidase is slow, active oxygen begins to be generated within the duration of ascorbate peroxidase, allowing it to survive, consistent with the results (Figure 6.-b). In addition, because the survival rate was high even when ethanol was added after adding NaCl, it is thought that salt tolerance improves even if the subject is soaked in salt solution. However, it appears that ascorbate peroxidase is less likely to be expressed during the production of active oxygen because the addition of ethanol and NaCl at the same time reduced the survival rate. This is because when ascorbate peroxidase can be expressed while active oxygen is being generated, the survival rate will be higher (Figure 6.-b c). Salt tolerance varies depending on the number of days from germination. It is believed that this is because ascorbate peroxidase and genes are likely to be expressed with growth.

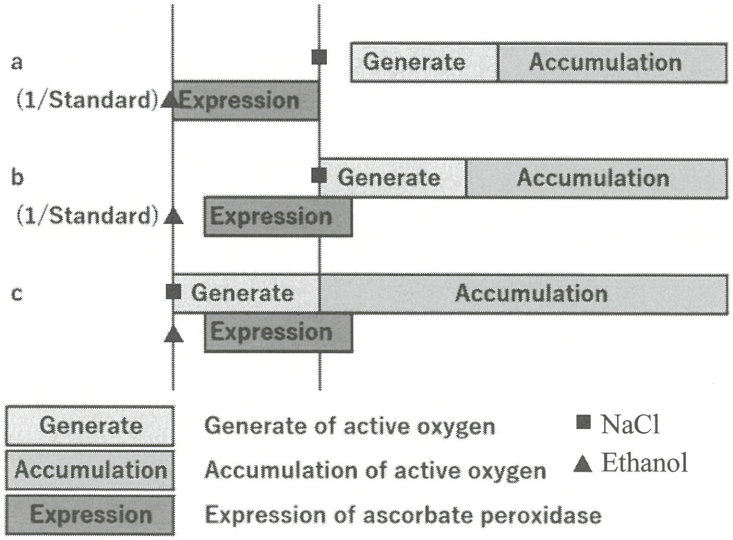

Figure 6 Timing of generate substances.

Conclusion

Salt tolerance developed because the survival rate was high when ethanol was given a low rate of the medium at about 0.2%. It is believed that the speed of production of active oxygen is no longer than the speed of expression of ascorbate peroxidase. Ascorbate peroxidase is less likely to be expressed during the production of active oxygen when the addition of ethanol and NaCl at the same time reduced the survival rate. Salt tolerance improves even if the subject is soaked in salt solution. Salt tolerance varies depending on the number of days from germination.

In this study, the survival rate was over 80% even without ethanol. This rate is much higher than previous studies, that shows about 20%, so it is likely that there was some difference in the experimental method or conditions, and it is an issue to clarify it. Moreover, since the color was judged by eye, the judgment standard varies each, so it is difficult to say that the result is an accurate experimental result. Next, I want to not rely on visuals but express the results using numerical elements such as chlorophyll quantification.

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Acknowledgments

Thanks to Kaori Sako and Motoaki Seki of RIKEN for their valuable advice.

Study of NaCl Density to Promote Growth of Lactic Acid Bacteria

Mao YOSHIKAWA Minori HORITA Kazuki FUKUMORI

Abstract

Lactoccocus lactis. subsp. cremoris is contained in Caspian Sea yogurt, and studies show that growth is promoted by NaCl. We therefore cultured three kinds of bacteria in nutrient mediums with varying NaCl concentration and measured their growth.

Key words: lactic acid bacteria, transmittance, concentration, halotoleramce

Introduction

Previous studies have shown that the growth of the lactic acid bacterium Cremoris in Caspian Sea yogurt is promoted by NaCl (Morichi, 1997). In this study, we investigated whether other kinds of lactic acid bacteria growth are promoted by NaCl and whether they depended on NaCl concentration.

These three kinds of lactic acid bacteria ware used in this study. These bacteria were obtained from the NBRC (National Institute of Technology and Evaluation).

(1) Bulgaria; *Lactbacillus delbrueckii* subsp. bulgaricus
Animal and bacilli. It is contained in plain yogurt and cheese.

(2) Cremoris; *L.lactis* subsp. cremoris
Animal and coccus. It is contained in Caspian Sea yogurt and cheese.

(3) Labre; *Lactobacillus* brevis
Vegetative and bacilli. It is contained in pickles and lactic acid bacteria drinks.

We hypothesized which concentration would promote the most growth.

(1) Bulgaria → Density is not related
Animal lactic acid bacterium has a low halotolerance, but the food these bacteria are generally used to make have high salinity levels.

(2) Cremoris → 0.5%
Results will be similar to previous studies.

(3) Labre → 2.5%
This is close to the density of pickles, and last year's findings were similar.

Materials and Methods

Experiment 1

(1) NaCl solution concentrations of 0%, 0.2%, 0.1%, 5.0%, and 25% were mixed with 5 ml and 5 ml of TYG medium. NaCl concentrations of 0%, 0.1%, 0.5%, 2.5%, 12.5% of each of the culture solutions (10 ml each) were prepared and cultured in an incubator at 37 ° C for Bulgaria bacteria and 30 ° C for Cremoris bacteria and Labre bacteria.

(2) Transmittance was measured 0 hours, 24 hours, and 48 hours later.

(3) After 48 hours of culturing, observed at 600x. The concentration of all cultures was 0%.

Experiment 2

(1) NaCl solution concentrations of 0%, 0.2%, 0.1%, 5.0%, and 25% were mixed with 5 ml and 5 ml of TYG medium. NaCl concentrations of 0%, 0.1%, 0.5%, 2.5%, 12.5% of each of the culture solutions (10 ml each) were prepared and cultured in an incubator at 30 ° C for Cremoris bacteria and Labre bacteria. These experiments were performed with two kinds of bacteria, because the Bulgaria bacteria had died.

(2) Transmittance was measured 0 hours, 14 hours, and 24 hours later.

Results and Discussion

Experiment 1

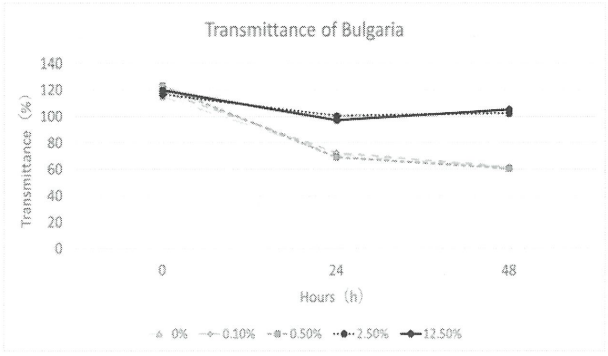

Figure 1 Transmittance of Bulgaria.

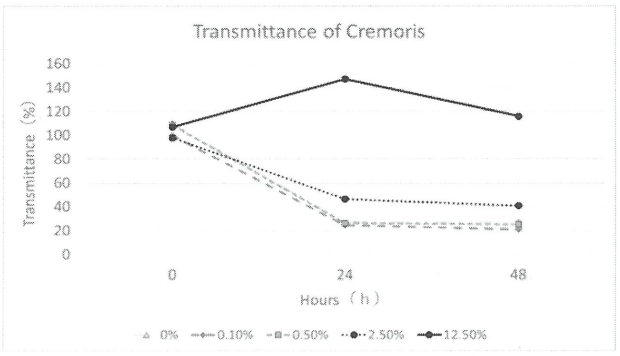

Figure 2 Transmittance of Cremoris.

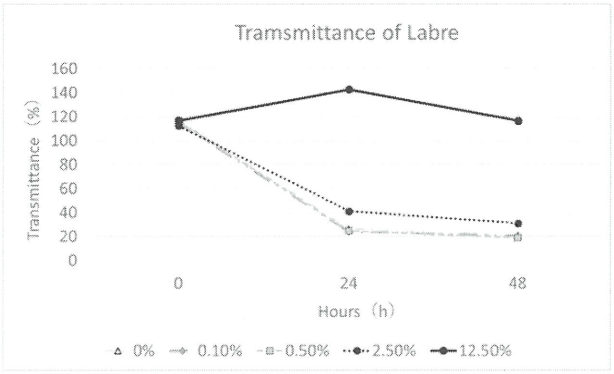

Figure 3 Transmittance of Labre.

Figure 1 shows a slight decrease in transmittance in Bulgaria, at 2.5% and 12.5%. *Figure 2* and *Figure 3* show a slight decrease in transmittance in Cremoris and Labre at 12.5%. It can be seen that the transmittance at 12.5% increased once and then decreased in Cremoris and Labre. Transmittance of all bacteria decreased significantly from 0 to 24 hours.

Bacillus were observed in Figure 4 and Figure 6. Coccus were observed in Figure 5. No bacillus and coccus were found in any of the pictures.

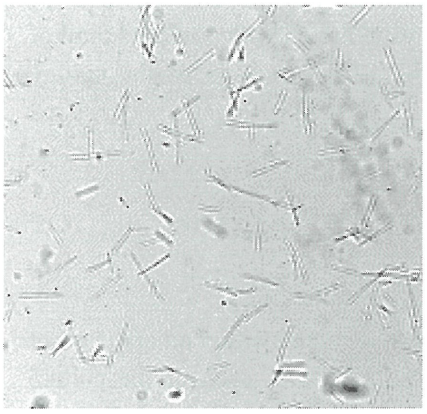

Figure 4 Bulgaria.

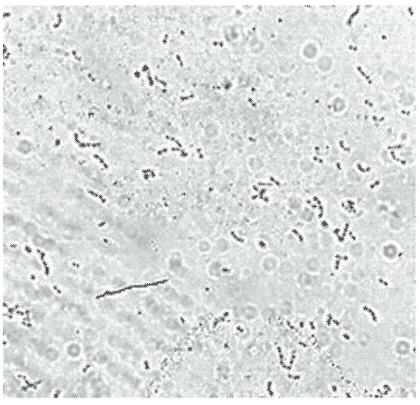

Figure 5 Cremoris.

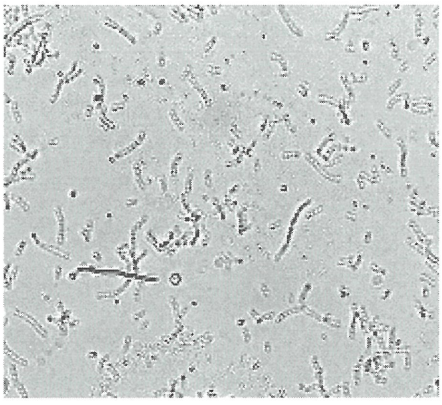

Figure 6 Labre.

Experiment 2

Figure 7 and *Figure 8* show a slight decrease in transmittance in Cremoris and Labre at 12.5%. The decrease in transmittance was almost the same as in Experiment 1. Transmittance of both bacteria decreased significantly from 0 to 14 hours.

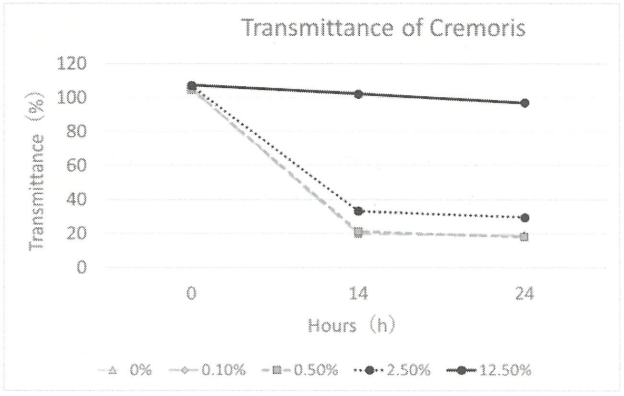

Figure 7 Transmittance of Cremoris.

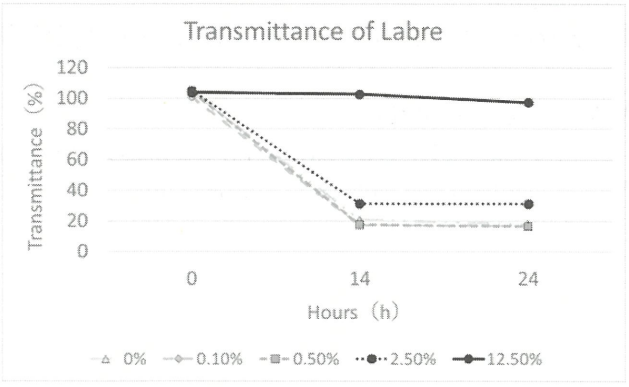

Figure 8 Transmittance of Labre.

Conclusion

The small decrease in transmittance when the concentration is high may be due to the effect of osmotic pressure or the salt tolerance originally possessed by the bacteria. In Figure 1, Figure 2, and Figure 3, the permeability of Cremoris and Labre was significantly reduced at 2.5%, but the transmittance of Bulgaria was reduced by 2.5%. From this difference, it is believed that Bulgaria has a lower salt tolerance than Cremoris, even with the same animal bacteria.

It can be said that the growth of lactic acid bacteria was suppressed by salt concentrations of 2.5% and 12.5% for Bulgaria and 12.5% for Cremoris and Labre. From this, it is believed that the three types of bacteria used in this study grow in a trace amount of salt, but have the property of a halophilic bacterium, whose growth is suppressed in an environment with a high salt concentration. The fact that the 12.5% transmittance of Cremoris and Labre in Experiment 1 increased is believed to be due to the generation of air bubbles. From Experiment 2, it was found that growth of both Cremoris and Labre progressed at an early stage after the culture was started. From this, it is believed that the growth of Bulgaria progresses at the same early stage.

Although the hypothesis predicted that there would be a clear difference in the NaCl concentration that promotes growth depending on the type of bacteria, the results of the three types of bacteria were similar in this study. From this, it is believed that the three types of bacteria have a common method of using NaCl when growing, regardless of the difference in the shape of the bacteria and the classification according to the habitat.

In previous studies, it was suggested that the growth of bacteria was promoted by NaCl, but in this study, no difference could be seen between the media with and without NaCl. This is because the culture medium to which NaCl is not added is an environment other bacteria can easily inhabit, and it is believed that bacteria other than lactic acid bacteria may have proliferated. Under microscopic observation, only bacillus were observed in the culture medium in which the bacillus were cultured, and only coccus were observed in the culture medium in which the coccus were cultured. Therefore, it is believed that bacteria other than lactic acid bacteria were not mixed. However, since the type of bacteria was not determined, bacteria other than lactic acid bacteria with the same shape may have been mixed.

The first problem was that we could not confirm that "NaCl promotes bacterial growth," as shown in previous studies. In the future, it is necessary to review and improve the experimental method and repeat the experiment. All experiments were performed in liquid medium, but if cultured on an agar medium as in previous studies, the type and number of bacteria can be visually confirmed, so it is better to change to agar medium. We also want to elucidate the mechanism by which NaCl promotes the growth of lactic acid bacteria. This was not found in previous studies.

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Acknowledgements

We thank Ms. Yoko Kiuchi for her help in doing this research. We received generous support from her. Without her help, we wouldn't have been able to progress with our research. Thank you very much.