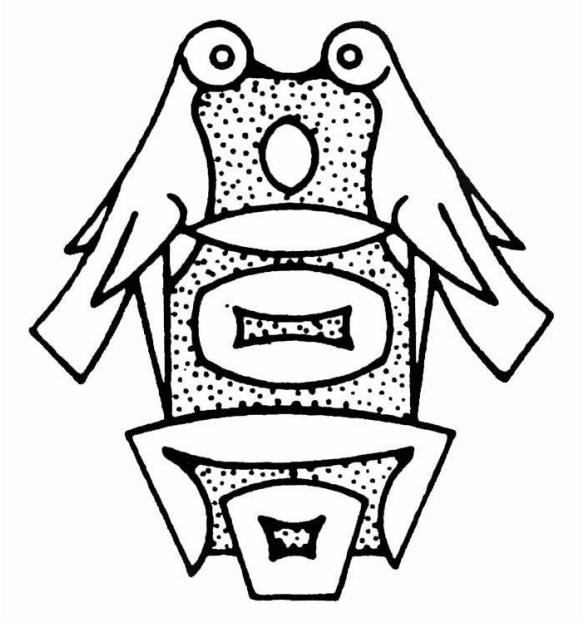
平成 26 年度３年理数科　課題研究

Super Science High School
The Collection of Researches



Nagano Prefectural Yashiro High School

Doctors Should Prepare Medicines According to Patients' Sex and Kind of Pollen

Ichinose Kosuke　Sakaguchi Minori　Horiguchi Erina　Wakabayashi Kazuya

1. Purpose

The purpose of our study is making proposals to doctors and cedar and hinoki pollen forecaster by analyzing big data.

2. Method

We used the "BuzzFinder" to analyze the data.　BuzzFinder is a software which counts specified words.　It can also show the positions of twitters and the number of tweets.　We analyzed the positions of twitters and the numbers of the tweets, given by both men and women, including such words as "*kahunsho*(pollen fever)," "*kushami*(sneeze)," and "*hanazumari*(stuffed nose)."

3. Result

Figure1　Number of the tweets including the word "kahunsho" by either sex

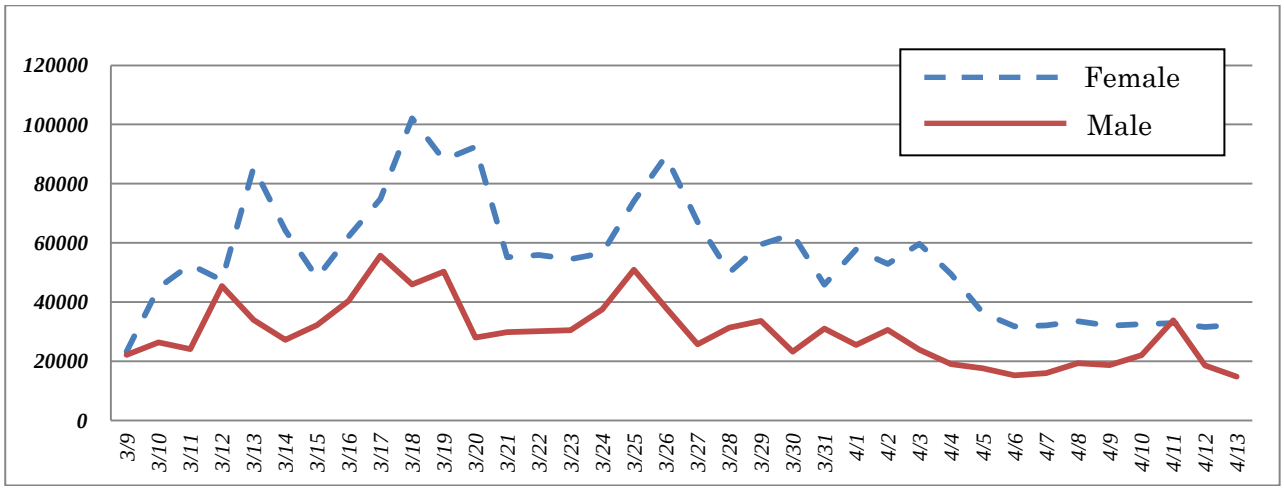


Figure 2　Number of cedar pollen counted each day

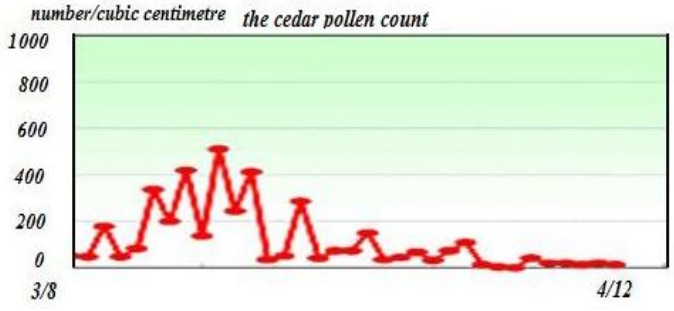
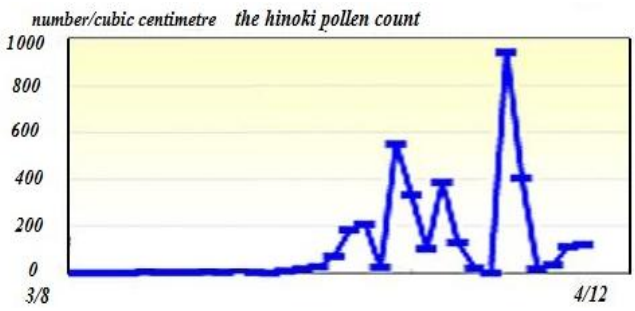


Figure 3　Number of hinoki pollen counted each day



In this study, we assumed that the numbers of the word "kahunsho" tweeted each day represented the number of the people who were suffering from pollen fever at the moment.　It suggests that cedar pollen causes women to suffer from pollen allergy, and cedar and hinoki pollen does harm to men.

Therefore, doctors should prepare medicines for hinoki pollen fever primarily to men when the number of hinoki pollen increases.　Also, numerical pollen forecasters should forecast according to the kind of plant.

4. Discussion

In this study, we did not take data of each prefecture.　It will probably show tendencies different in each area.

5. Citation

http://www.hosp.go.jp/~sagami/sinryouka/kafunsyo.html#CYPRESS_POLLEN

Correlations between the Conditions of the Touch of a Fork onto a Plate and the Occurrence and Frequency of Disgusting Noises

Sodeyama Ryu　Takasawa Tsubasa　Hoshina Akihiro　Aoki Tomoya　Taguchi Taiki

1. Purpose of the study

We did research on what causes a “disgusting noise” to occur when we scrubbed a plate with a fork and suggested ways to prevent it from occurring.

2. Methods

We prepared the equipment as Figure 1 shows. We moved the handcart back and forth and examined the correlations between the frequencies of noises that occurred, the angles between the fork and the plate, and the forces the fork gave to the plate. Also, we changed the conditions by making the points of the fork rough. We used criterions of frequency we made in order to judge whether the noises that occurred were disgusting.

Figure 1

3. Results

We divided the noises produced into two groups depending on their frequency, and defined the noises that have high-frequency as “disgusting noises.” The results showed that any noises, made with the angle θ, 75°≦θ≦110°, are “disgusting noises”. The forces and the shapes of the points of the fork have nothing to do with the frequencies of the noises, but the decline in the forces prevent the noises from occurring. We concluded that the frequencies that occurred could be used as an indicator to judge how disgusting the noises were.

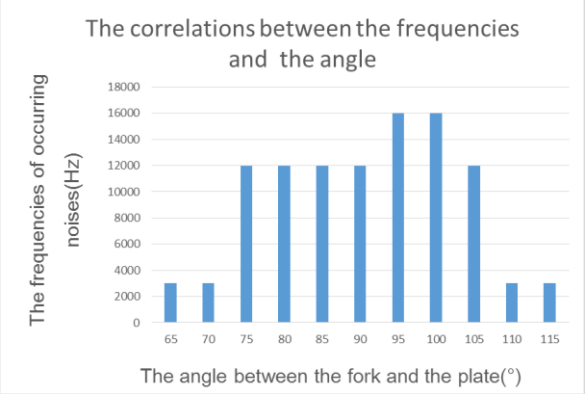


Figure 2

4. Discussions

We guess that the center of gravity of a fork moved greatly as the angles altered from 70° to 75°, from 105° to 110°. The shift of the angles might have affected the creation of the disgusting noises. We will examine in the future how the centers of gravity of a fork will shift according to the angles it holds to the horizontal object.

5. Citations

Oto no sokutei to oto taisaku, Nagano Prefecture General Industrial Technology Center

Q and A, http://www.asj.gr.jp/qanda/001050.html　Acoustical Society of Japan

Sound Engine Free, http://soundengine.jp/

AviUtl, http://spring-fragrance.mints.ne.jp/aviutl/

NFFT, http://www.nahitech.com/nahitafu/nfftdown.html

What Causes Occurrences of Whirlwinds?

Kano Nozomi　Nakamura Miwako　Minemura Nozomi

1 Purpose of the investigation

A whirlwind occurs at such places as school ground and a corner of a building. However, we know little about how it occurs. In this study we made artificial whirlwinds and examined how they occurred. We divided whirlwinds into the following two groups, [A] and [B]:

[A] The air near the ground which has become hot and whirled up due to the sunlight; it looks like a tornado

[B] Winds which have whirled up due to a cold blast, or have blown between buildings.

2 Method

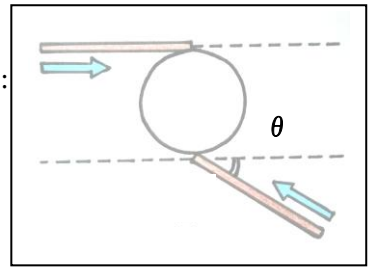
(1) Experiments

We observed whether or not the wind has occurred by the following experiments:

Experiment A: We just ignited "*Hebihanabi* (firework which emits smoke)" and examined whether or not whirlwinds would occur. [A]

Experiment B: We created artificial updrafts by using hot water and blew horizontal winds from the opposite directions. We changed the blowing angles. We first set the angle at 0^o, that is, completely opposite directions. We changed the angle θ from 0^o to 80^o (the case of 30^o is shown in Figure 1). We examined how whirlwinds would occur. [A]

Figure 1



Experiment C: We vertically put two boards with a right angle between them. We blew the wind along one board and made whirlwinds at the corner. We observed how whirlwinds were blowing. [B]

(2) Research of whirlwinds that occurred in the past

We searched the spots, times, wind directions, and temperatures at which whirlwinds occurred using the Internet and books, and compared them with the ones we got from weather maps.

3. Results

(1) Experiment A: We couldn't find any whirl of smoke because the smoke was blown off by the wind. [A]

Experiment B: The steam whirled most when we blew the wind in the following conditions: the angle θ: 0^o to 20^o, the height of the wind: 0 to 10cm. [A]

Experiment C: We could find the occurrence of whirls of smoke but they were unstable. [B]

(2) We found the following tendencies:

(a) When it was sunny and blowing weakly, there was a great difference between the highest and the lowest temperatures on the day. As a result, the whirlwind occurred frequently.

(b) The prefectures where many whirlwinds occurred in the past were Gunma, Tochigi, Shizuoka, and Nagano.

4. Consideration

(1) Whirlwinds occurred easily under the following conditions:

when the winds were too strong, the smoke could not whirl (Experiment A [A]);

when the winds blew from almost completely opposite directions and meet just above the ground, whirlwinds occurred well (Experiment B [A]);

when the wind blew horizontally at the corner of a building (Experiment C [B]).

(2) In Gunma and Tochigi prefectures, there are vast flatlands and thunders frequently occur, so type [A] whirlwinds are likely to occur. In prefectures near the sea, whirlwinds easily occur due to winds blowing from the sea.

In Nagano prefecture, its flatlands are small, so whirlwinds occur due to cold air current. As a result, type [B] blasts can be seen more easily than type [A] blasts.

Make a Chocolate Whose Melting Point is High

Moe Yuhara　Chihiro Nakasone　Kaho Natsume　Hiroko Hasegawa

1. Purpose of the Study

Chocolates tend to melt easily when it is hot.　We examined how to raise a chocolate's melting point.

2. Method

(1) We made chocolate from cacao butter, cacao powder, and powder sugar.　We melted pieces of chocolate with a constant temperature reservoir and measured the chocolate's melting points when the amount of solid chocolate became equivalent to that of liquid chocolate.

(2) We put various amounts of sugar in melted chocolate and measure the chocolate's melting points.

(3) We put various kinds of fat in melted chocolate and measure the chocolate's melting points.

3. Results

(1) Figure 1 shows the results of (1) and (2). The more amount of sugar was added to the chocolate, the lower the chocolate's melting points became.　Considering the results, the chocolate's melting points were affected by destruction of the structure of cacao butter by sugar molecules.

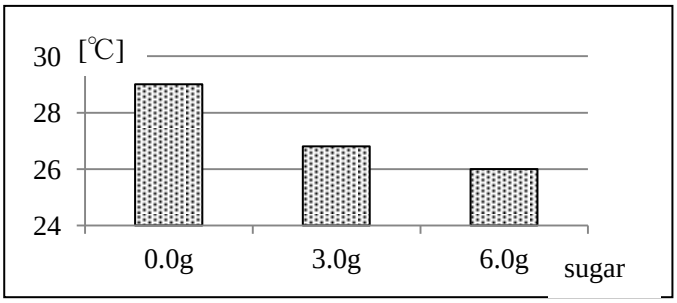


Figure 1

(2) Figure 2 shows the results of (3).　The melting point of beef fat chocolate was higher than that of cacao butter chocolate, but those of palm oil and of palm olein are lower.　Considering the results, the chocolate's melting points were affected by how much fatty acid was included in fat.　Figure.3 shows the proportions of fatty acids included in each kind of fat.　The larger molar weight the saturated fatty acid added to the chocolate has, the higher its melting point.　Therefore, we should have used the fat that contained a large amount of stearic acid.　Cacao butter and beef fat contain a large amount of stearic acid, but palm oil and palm olein do not, so the melting points of palm oil and palm olein chocolate were lower.

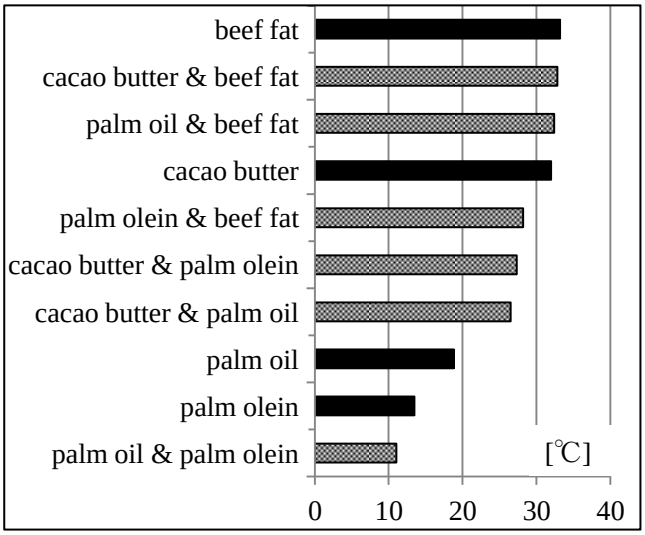


Figure 2

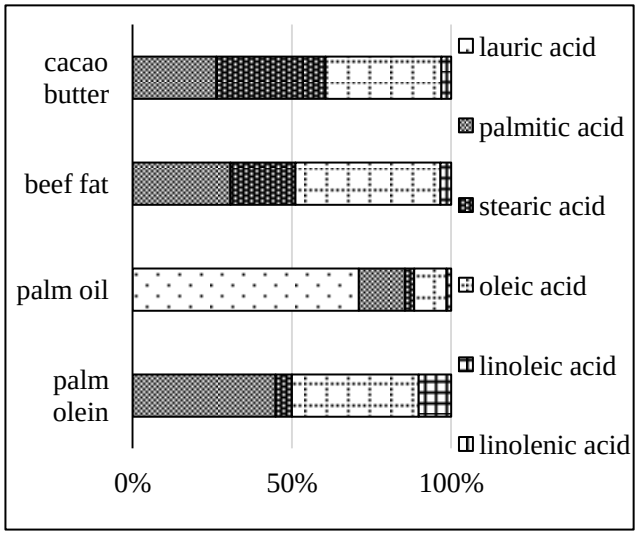


Figure 3

Hydrolysis of PET Bottles by Sodium Hydroxide

Koide Kenshiro　Karasawa Daichi　Tanaka Yudai　Yokota Naoya

1 Purpose of the study

PET bottles can be dissolved by sodium hydroxide.　We thought that by using the method we could separate such PET bottle's raw materials as terephthalic acid from the rest.　We first learned the way of dissolving PET in detail and started this study.

2 Method

First we specified the conditions suitable for the PET dissolution.　We dissolved pieces of PET bottles in a total of 18 patterns: three patterns of mass concentration of sodium hydroxide (5%, 10%, and 20%), and six patterns of dissolving time (one, two, four, eight, 24, and 48 hours).

Second we dissolved PET pieces by 20% sodium hydroxide solution. We set six patterns of dissolving duration (one, two, four, eight, 24, and 48 hours) and observed how they were dissolved under a polarizing microscope and used paper chromatography to analyze what were left there as lysates.

As a way of paper chromatography, we added hydorochloric acid to the solution of PET bottle to precipitate the lystates.　We centrifugated the lystates to remove the salt from them.　We dissolved pure terephthalic acid by sodium hydroxide in order to compare it with the lysates.　We used propanol aqueous solution as developing solvent.　We used the iodine to color the spots which developed.

We dissolved the lystates by sodium hydroxide and spotted the solution to the center of the paper (Figure 2). From left to right we can see the results of the development of the six patterns of solution (one, two, four, eight, 24, and 48 hours).　We spotted the solution of pure terephthalic acid at both ends of the paper so that we could easily compare the results of the two kinds of solution.

3 Results

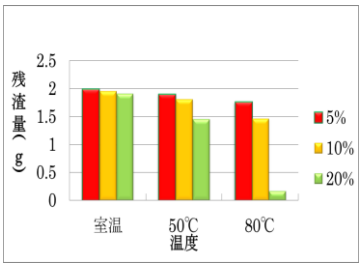


Figure1

As Figure 1 shows, the PET dissolution proceeded rapidly when the mass concentration was high and the dissolving time was relatively long.　We discovered that using a polarzing microscope, the dissolved PET bottle's surface looks like craters.　These craters became smaller as dissolving time become longer.

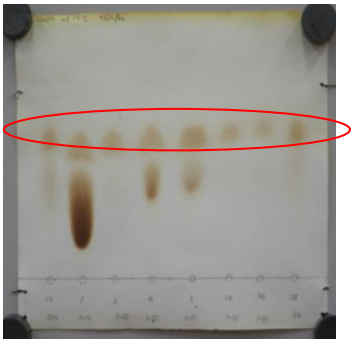


Figure2

Figure 2 shows the results of the second experiment's paper chromatography. As you see in the red circle, the developments of lysates and terephthalic acid spots appeared at the same level.　We assumed, therefore, that these substances are the same.　We concluded that the substance which we got from dissolved PET bottles is terephthalic acid.

4 Discussion

We cannot identify the substance which appeared as the spots under the red circle. We assumed that the substance would be chemical salt.　Now we are identifying what the substance is.

Making Biodegradable Plastics with Wasted Apples

Washizawa Moe　Takeuchi Hina　Takizawa Kanako

1 Purpose of this study

Nagano has the second largest production of apple but its disposal rate is as high as 15%.　We thought that we should make good use of these wasted apples for making biodegradable plastics.

2 Method

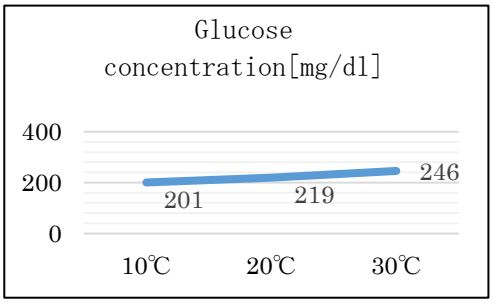
Cellulose is a kind of sugar which consists of a linear chain of glucose units.　We thought that we could produce plastic materials by using glucose decomposed from cellulose.　We broke down cellulose into the glucose by using cellulose, an enzyme which breaks down cellulose.　In this study, we investigated under what conditions we could produce much glucose.

We made a basic sample adding cellulase and buffer solution into the pomace of the apple.　Then, we changed the amount of cellulose, the pH of the buffer solution, and the preservation period, then we examined under which condition glucose is produced most.

3 Result

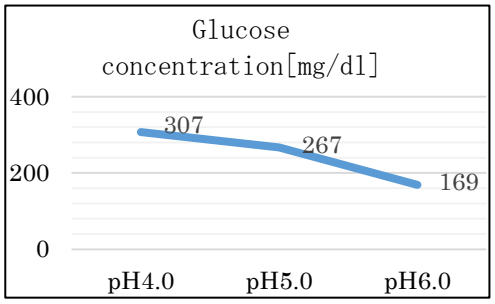
(1) We changed the temperature during the preservation period: 10°C, 20°C, and 30°C.　When we preserved it at 30°C, we could produce the glucose most. (Figure 1)

Figure 1



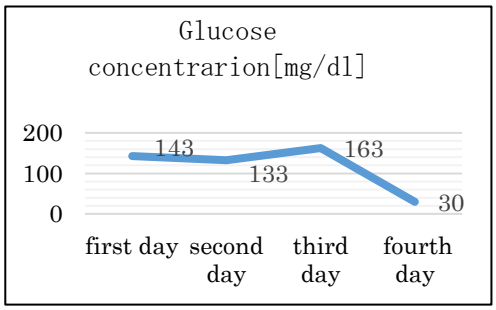
(2)We changed the pH of the buffer solution during the preservation period: pH4.0, pH5.0 and pH6.0.　When we preserved it in the buffer solution of pH4.0, we could produce the glucose most. (Figure 2)

Figure 2



(3)We changed the preservation period from one day to seven days.　As the graph on the right (Figure 3) shows, the fourth day saw the highest result in the density of the glucose was not stable during the period, contrary to the expectation.

Figure 3



4 Discussion

We expected that the amounts of glucose concentrated would increase every day, but actually they did not.　The results may have varied greatly depending on the degree to which we mixed the samples.　We should have mixed the samples well.

The voices which help plants grow

Seki Takeharu
Tsuchiya Kohei
Nishimori Masaru
Yamamoto Tatsuki

1. Purpose of the study

We wondered if voices have some effects on the plant's growth. Especially, we paid attention to differences between effects of cheering voices and scolding voices. Therefore, we examined how the sound affects plant's growth.

2. Method

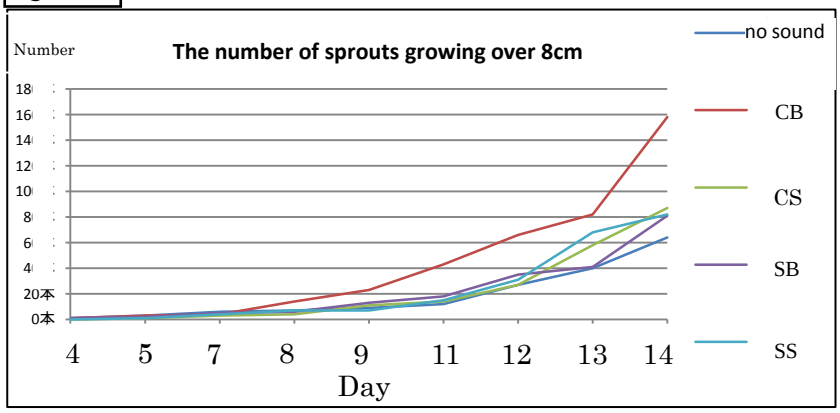
At first, we recorded two kinds of one male examiner's voice. One kind of voice was his cheering voice and another was his scolding voice. We separated the recorded voices into big ones and small ones. Second, we exposed each group of bean sprouts in each kind of voice every night for two weeks. We will refer to the bean sprouts which were grown hearing big cheering voices as "CB"; we will refer to the sprouts hearing small cheering voices as "CS"; we will refer to the sprouts hearing big scolding voices as "SB"; and which we will refer to the sprouts hearing small scolding voices "SS". We measured the heights of them every day.

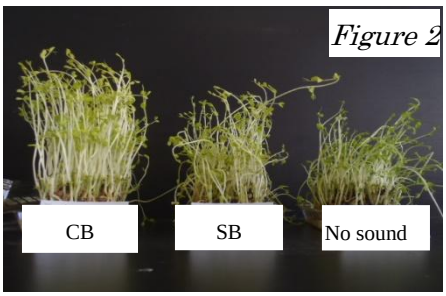
3. Results

We got the following data from the experiment. Figure 1 shows the number of sprouts which grew over eight centimeter. We can read that CB was the highest of all, CS, SB, SS followed, and no sound group was the lowest. Figure 2 shows the differences of the bean sprouts' heights 30 days after the experiment started.

We can guess that the cheering voices had bigger effects on plant growth than the scolding ones, and the big voices also had bigger effects on plants than the smaller ones.

Figure 1





4. Discussion

We have not discovered elements which help plants grow faster yet.

We would like to continue this research and find the elements in the future.

Alcoholic Fermentation with Alginic Acid Beads

Keisuke Kanisawa　Yusuke Ozawa　Shinya Koyama

1 Purpose of our study

Alcoholic fermentation is an anaerobic reaction in which yeast fungi decompose sugar into ethanol and carbon dioxide. Normally, alcoholic fermentation is produced by yeast fungi. We thought, however, that we could improve the reaction efficiency by adding certain substance to yeast fungi and using them repeatedly. We had learned that yeast fungi fixed in alginic acid beads could be beneficial for using yeast fungi repeatedly.

2 Method

After adding a drop of alginic acid sodium into calcium chloride, we got gelled beads called "alginic acid beads". By mixing yeast fungi in alginic acid sodium we could make alginic acid beads containing yeast fungi.

We made 400ml of glucose solution in which 15 percent of sugar was contained. Then we divided it into 200ml for each. We put alginic acid beads with yeast fungi in one (A). We put only yeast fungi in the other (B). We fermented both of them in a bath of water whose temperature was kept at 37^{o}C for three days. We observed the change in the sugar contained. Three days later we took out alginic acid beads with yeast fungi from A solution, and yeast fungi from B by decompressing filtration.

We conducted the operation three times.

3 Results

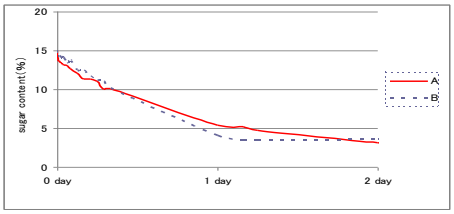


Figure 1

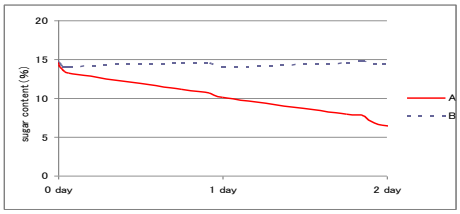


Figure 2

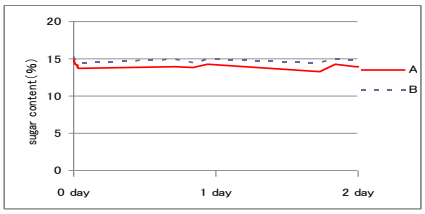


Figure 3

In the first operation both of the sugar contents decreased to 3% in two days. The decreasing rate was relatively gradual (Figure 1). In the second operation, A's decreasing rate became more gradual than that of the first time, and its sugar content decreased to 5% in two days. By contrast, B's sugar content stayed almost the same after the first 30-minute decrease (Figure 2). In the third operation, both A's and B's sugar contents hardly changed; only A's sugar content slightly decreased by 1.5% (Figure 3).

We had expected that B's fermentation would be more quick than A's, because B's yeast fungi can get glucose directly from the solution. However, there were no differences between the results of A and B, so we consider that the yeast fungi fixed in alginic acid beads did not prevent yeast fungi from alcoholic fermenting.

In the second operation, B's yeast fungi would have been dead somehow because B's sugar content did not decrease. Since A's sugar content kept decreasing steadily, being fixed in alginic acid beads would have helped yeast fungi keep living in the solution. According to the results, we consider that yeast fungi being fixed in alginic acid beads have two advantages: one is that we can use yeast fungi again and again. The other is that we can take out yeast fungi easily.

Finding Conditions to Culture a Large Amount of Euglenas

Hikari Tozawa　Karin Fuji　Mao Yoshihara

1. Purpose of the study

According to the precedent studies, euglenas make wax eater as a fuel in their bodies when they are in aversion. We extracted wax ester along with the precedent studies and investigated under what conditions we could culture larger amounts of euglenas.

2. Method

First, after we used a centrifuge for ten minutes for taking out euglenas. Second, we left them at rest in an incubator in a darkroom over forty-eight hours. Third, we poured into a separating funnel culture solution that had been left at rest over forty-eight hours. Fourth, we put diethyl ether and hexane into the solution and mixed well. Fifth, after culture solution was deposited, we threw the solution away and poured the remaining diethyl ether and hexane into an eggplant flask. Sixth, we dipped the eggplant flask in the water whose temperature was at 50^{o}C in a water tank with a rotary evaporator. Seventh, we evaporated diethyl ether and hexane by a rotary evaporator. Eighth, only wax ester remained within the eggplant flask.

Next, we changed the temperatures inside the incubator, the kinds of cultural fluid, and the colors of the light in the incubator in order to investigate better conditions to culture a large amount of euglena; the temperatures were set between 23^{o}C and 25^{o}C; the cultural fluids were fluid fertilizer, Knop's solution, and tap water; the colors of the light were white, yellow, red, blue, and green. We diluted fluid fertilizer that was ordinarily sold in a shop.

We counted the number of euglena that were cultured with plankton counting slides.

3. Results

We could get the largest amount of euglenas when they were cultured in 25^{o}C, in fluid fertilizer, and under white light. As for the temperature, there was little difference between the numbers of euglenas produced at the temperature of 23^{o}C and that produced at 25^{o}C. In terms of the cultural fluid, fluid fertilizer was the most useful of the three. We had expected that we could get larger amounts of euglenas cultured in Knop's solution than in tap water. However, we saw the opposite results. As for the colors of the light, we had expected that it would be the best to culture euglenas under a red or blue light because chlorophylls absorb red and blue lights more than other colors. However, we discovered that culturing euglenas under white light was the best.

Figure 1

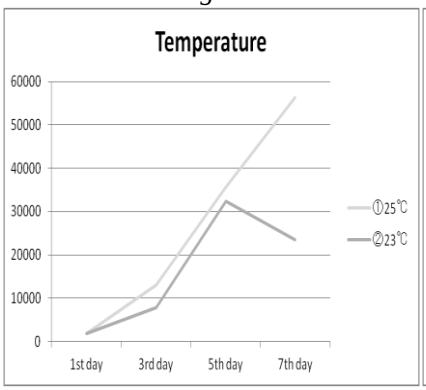


Figure 2

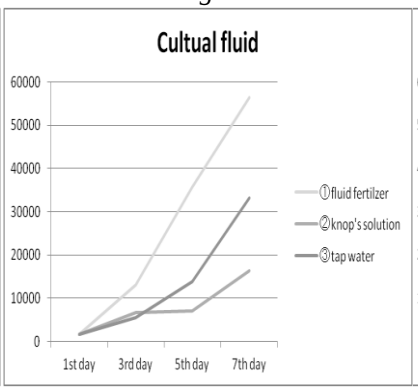
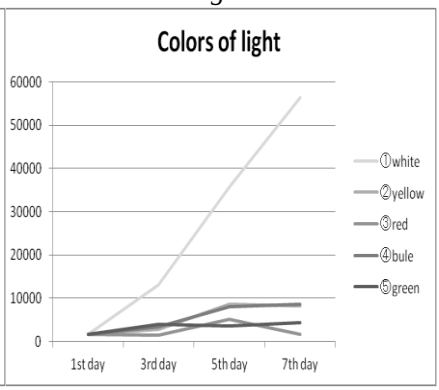


Figure 3



4. Discussion

As for the temperature of the cultivation, the manual of the cultivation kit of euglenas says that 29^{o}C would be the most recommendable. When we cultured euglenas at 29^{o}C, however, the number of euglenas decreased. Therefore, we cultured them in the solution between 23^{o}C and 25^{o}C. Judging from the decrease in the number of euglenas at 23^{o}C, we may have made some mistakes in the measurement. As for the solutions, too much iron in the Knop's solution may have prevented euglenas from growing their number. Besides, the density of the Knop's solution was probably lower than that of the fluid fertilizer. As for the color, we wrapped the beakers used for culturing euglenas with color cellophanes, but we did not wrap the beaker with white cellophane. Therefore, there would have been big differences in the luminous intensities. By watching the euglenas through a microscope and comparing the images to those from the precedent research, we could find only tiny amounts of wax ester produced by the euglenas, but they were too tiny to be extracted.

5. References

ワックスエステル高含有ユーグレナの生産方法及びワックスエステル製造方法
http://www.ekouhou.net/disp-A, 2012-23977.html
ワックスエステル高含有ユーグレナの生産方法 http://www.google.com/patents/WO2013115288A1?cl=ja

Toward a Higher Hit Rate

Arakawa Naoya　Kobayashi Nagatomo　Miyagawa Takehiro

1. Purpose of the study

As for Japanese art of archery, an arrow normally shot blows up and flies upwards. In order to make an arrow hit the target, however, we need the power of twisting a bow. If we shoot an arrow without twisting a bow, the arrow flies to the right. We investigated how landing points moved according to the angles of the hand twist and analyzed how an arrow flies. This analysis will lead to the accuracy of our target hitting in the future.

2. Method

First, we investigated on the correlations between the pulling forces and the following three kinds of forces: the force exerted on the upper part of the bow string, the force on the lower part of the bow string, and the force on the entire bow string. We conducted experiments with three kinds of bow with different tensions.

Second, we investigated on the correlations between the angles of the twist in holding a bow and changes in its landing point. Making twists in holding a bow was difficult for us, so we used a device for fixing a bow.

Figure 1

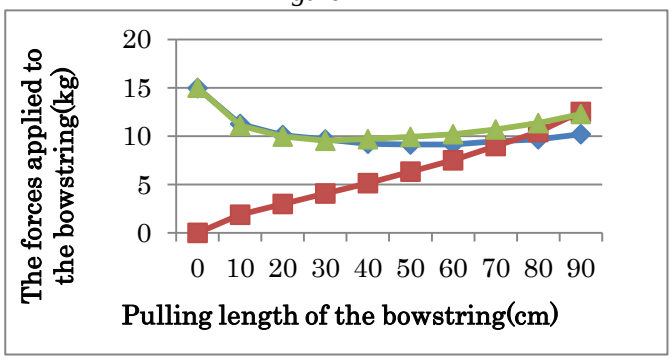


Figure 2

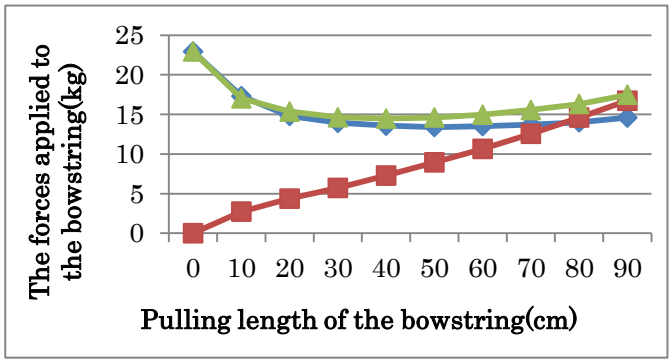
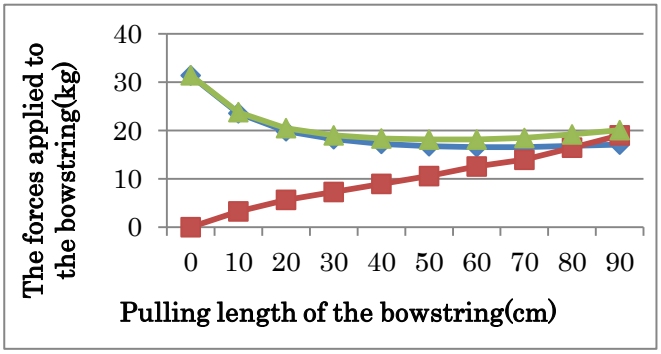


Figure 3



3. Results

In the first experiment, when we pull the bowstring from one point, the tension of the lower part of the bow increased suddenly, and we reached the point where we could not pull it straight without leaning the bow forward. We show the tension on the upper part of the bow by square mark, the tension of the lower part of the bow by triangle mark, and the tension on the entire bow by diamond mark (Figures 1 to 3). We found that this pulling point was related to the forces applied to the bowstring. The further we pulled up the bowstring, the stronger the forces.

In the second experiment, the landing points of an arrow were shifted to the right unless we twisted the bow. The arrows flew straight to the target, if the bow was twisted by 6 °.

4. Discussion

Flying distance of the arrow is determined by leaning the bow and arrows flies upwards. And deviation of the horizontal is determined by twisting the bow.

From the above, you are able to control landing point of arrow on the angle of leaning and twisting the bow.

A Relation between Soil Liquefaction and Sizes of Particles of the Soil

Toda Itsuki　Koiwa Taisuke　Nozawa Tosiki

1. Purpose of the study

The great earthquake on March 11, 2011 caused extensive damage of soil liquefaction to Chiba and Saitama prefectures, which are hundreds of kilometers away from the hypocenter.　It is known that the occurrences of liquefaction are influenced by the earthquake's vibration period, acceleration, continuation time, and the place's soil hardness and its particle sizes.　Among these factors, we determined to study about how particle sizes would be related to the liquefaction.　We conducted an experiment by using a miniature model of soil.

2. Method

(1) Poured 200g water into Tupperware

(2) Put sand in it until there was no water on its surface

(3) Put nine pieces of paper cut in 1.5cm×1.0cm

(4) Gave vibration to the Tupperware for five minutes and measured the time when the liquefaction started

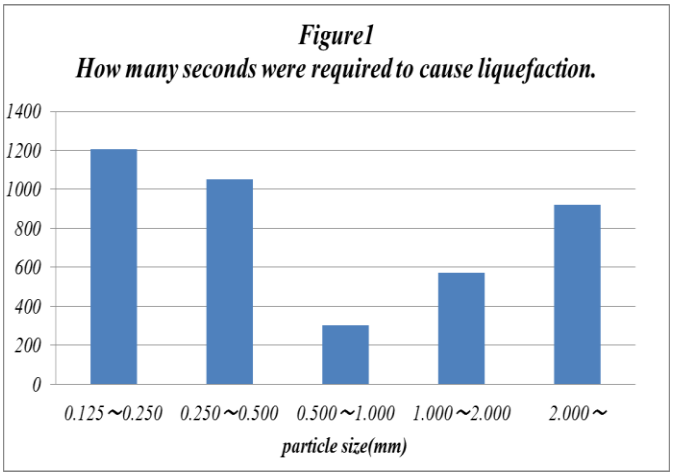
(5) If there was no liquefaction, raised a level of vibration and gave it once again

(6) Repeated (4) and (5) until liquefaction started

3. Results

We had expected that the smaller the particle sizes were, the quicker the liquefaction would start. However, as Figure1 shows, the particles the size of 0.5 to 1.0 millimeters caused the liquefaction most easily.

Figure1
How many seconds were required to cause liquefaction.



4. Discussion

In general, liquefaction is caused by increasing the water pressure around the particles.　To increase the water pressure the water should not have any escape route.　In other words, if there are some escape routes, the risk of liquefaction will decrease.

In this study, because we used large sizes of particles (over 1.000mm), the Tupperware had enough space between the sand particles for water to escape.　Therefore, the sands were hard to liquefy.　On the other hand, when we used small sizes of particles (0.125 to 0.500mm), the spaces between them were smaller than those when using other sizes.　In this case, the Soil was solid and the soil structure was difficult to collapse. As a result, liquefaction did not easy occur.

According to the precedent research, researchers sampled real soil.　Real soil consists of many kinds of particles and it is different from the soil used in this study.　We are planning next experiments, in which we will use different sizes of particles and measure the water pressures among the particles.

5. Citation

グラベルドレーン工法の液状化被害軽減効果に関する実験
http://www.jstage.jst.go.jp/article/proee1997/24/0/24_0_497/_article/-char/ja/