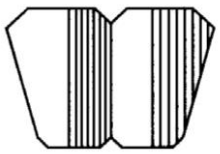
THEMATIC RESEARCH II

Annual Report on Research Activities

Abstracts in English



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Can Natto Generate More Ammonia from Okara?

Akiyuki Nagasawa, Yuka Shimizu, Sakura Saito, Mei Higashiguchi

Abstract

Our purpose is to create ammonia efficiently with natto bacillus. We aim to establish a new way to generate green ammonia. We thought the amount of ammonia produced was due to the length of time fermented. In this experiment, we added 0.5ml of water which contains natto bacilli and 25ml of pure water to every 25g of okara and put them into freezer packs. We left them in the laboratory equipment which was kept at about 40 degrees Celsius for 4~7 days and for 1~3 days. After that we added 100ml of pure water. Finally, we titrated the amount of ammonia in that solution with 0.005mol/L sulfuric acid. Our sample showed, before day 4, the amount of ammonia and time of fermentation were proportional and the numbers did not increase after day 5. We thought this was caused by losing materials to generate ammonia in the middle of fermentation. We searched the details of how natto bacilli generates ammonia. We found the natto bacillus has two ways of generating ammonia: using glutamic acid and the urea circuit. In the future, we think that we will finally be able to generate a lot of ammonia by increasing urea or glutamic efficiency.

Keywords: Ammonia, natto bacillus, okara, fermentation, eco-friendly

Flip the Secret of pH Lipsticks

Momoe Tsuge, Momoka Kobata, Chisato Hatano, Koko Inoue, Yuzuka Takagi

Abstract

The purpose of our experiments is to reveal the mechanism of the color change of the pH lipstick. The pH lipstick is a rouge which changes its color when put on lips. It is said that the causes of this phenomenon are our body temperature, the amount of water, and/or the pH of our lips. We hypothesized that specifically pH is the factor that changes the color of pH lips. In these experiments, we used the lipstick (SENSUAL NUDE BALM #101 JALAPEÑO PEPER®, HERA, South Korea). We investigated whether the color change of pH lipstick is caused by body temperature, the amount of water, or pH. First, we dissolved a lump of the lipstick in pure water and heated it. Second, we applied the lipstick to a wet filter paper. Third, we put a lump of the lipstick on cellophane wrap and dripped various chemicals on to it. Fourth, we dissolved a lump of the lipstick into ethanol. Fifth, we applied the lipstick to various things such as skin, ordinary papers, filter paper, cellophane wrap, and oil blotting paper. Sixth, we observed the structure of lipstick by using a microscope. These six experiments revealed that body temperature, the amount of water, and pH have nothing to do with the color change of the pH lipstick. Therefore, we found that our hypothesis that pH has something to do with the color change of lipstick was not true. The structure may consist of a small amount of purple-colored water inside and a large amount of green-colored oil on the outside. The change in lipstick color is thought to be caused by taking water out of the oil layer. However, it is not changed by superficial impact, so the properties of the oil must be changed or the oil itself must be removed to change the color of lipstick.

Keywords: pH, color, lipstick

Examining Ramsden Phenomenon with Soy Milk

Kotomi Aoyama, Nanao Sakamoto, Yuko Nakajima, Tomoe Nara

Abstract

The purpose of this project was to create a strong film, making a vegetable-based film, and incorporating it into real life by focusing on the phenomenon where a film forms when soy milk is heated. We heated 100 ml of soy milk which had nothing added, as well as others in which various kinds of components were added to change the conditions. We call the former Sample A, the latter Sample B (1) to B (5). To Sample B (1) was added 0.25 ml of coconut oil and 0.75 ml of detergent for emulsification, to Sample B (2) was added 0.1 g of gelatin, to Sample B (3) was added 0.1g of agar, to Sample B (4) was added 0.6 g of NaCl, and to Sample B (5) was added 0.3g of super absorbent polymer. We compared the strength of these films by measuring the weight of the water which was put in the film and then hung. The results were as follows. Sample A withstood about 250g of water on average. Sample B (1) withstood 95.3g, Sample B (2) withstood 168.2g and 562.7g, Sample B (3) withstood 346.9g, Sample B (4) withstood 40.2g, and Sample (5) withstood 397.7g. Based on these results, we believe that fibrous materials make the film stronger, and less moisture content steamed from water surface makes the film weaker. Sample B (2) showed a big difference in strength, even when we conducted the experiment under the same conditions. No obvious trend was observed from this result, but we deduced the film's strength has some connection with age of soy milk. We are planning three experiments for the future: Researching the relationships to thickness of films, weather conditions such as temperature and humidity, and age of soy milk. Furthermore, we want to develop methods that allow for long-term preservation while maintaining its strength.

Keywords: Ramsden phenomenon, soy milk, bioplastic, film

Project X "Visitors"　~Analysis of Kyoto Tourism Using X~

Yoshiki Nakai, Yuki Yoshida, Ryuji Okahashi

Abstract

The purpose of our research is to solve the problem of over tourism in Kyoto Prefecture by attracting people to unpopular tourist destinations. Kyoto is a very famous tourist destination in the world, and with the covid19 infection subsiding, the number of tourists is increasing. However, many tourists visit the same place at the same time, which reduces the quality of tourism and has a negative impact on the local residents. We did some research on tourism in Kyoto using X, thinking that this problem could be solved by attracting tourists to less popular tourist destinations and dispersing them. We examined 136 posts. Kiyomizu Temple 44, Fushimi Inari 38, Yasaka Shrine 32, Kinkaku Temple 24, Arashiyama 24, Togetsu Bridge 22, Kyoto Station 20, Kyoto Aquarium 12, Kibune Shrine 12…Many of the postings were about famous tourist attractions. In the course of our research, we found many postings of photos taken with photos or plush toys of anime characters. We thought that many people might be sightseeing for the purpose of supporting their favorite anime and pilgrimages to the place where their favorite anime was filmed, which has become a hot topic recently.

Keywords: X/ Twitter, Tourism, statistics, anime, research

The Balance between Building Height Limits in Kyoto City and Urban Development

Sarane Sugimoto, Mai Wada

Abstract

The purpose of our research is to find ways to preserve the beautiful Kyoto landscape for future generations. Kyoto City is clearly different from other cities, towns, and villages in terms of appearance: specifically the height of its buildings. This is due to landscape protection, and Kyoto's landscape is protected in many other ways, including color and design. On the other hand, these regulations also restrict our economic activities. As a matter of fact, the history of height restrictions has been a struggle of interests between residents and the government. Therefore, in order to investigate whether height restrictions are really useful, we conducted a fieldwork survey based on the results of a questionnaire survey on the awareness of Rakuhoku high school students toward the landscape. The survey revealed that many people consider rivers to be an important part of Kyoto's landscape, so we studied the ratio of natural to man-made features along the Kamo River. We found that many people considered the river to be an important landscape in spite of the large number of temples and shrines in Kyoto, which we attributed to the fact that the river landscape is in good harmony with nature and buildings. Harmony of sky and natural and man-made objects is the most important factor in achieving a balance between development and preservation.

Keywords: Kyoto, urban development, nature, city, height

Not Shaving Hair Is Not Shame in Care

Yusuke Kawashima，Koki Uchida

Abstract

The purpose of this project was to find out if there is social pressure to force hair removal. For example, it is obvious in Japan that there are more women who remove their hair than men who do so. However, we don't know if this is something they want to do or if they are forced to remove their hair by social pressure. We tried to ascertain whether social pressure existed or not. In order to do that, we conducted a survey of students at Rakuhoku High School. Survey results showed that social pressure exists, especially against women. Additionally, those who think that social pressure exists felt this way from the media, the web, magazines, and the internet. In recent years, social media has developed rapidly, and a variety of information is circulating. As a result, information promoting hair removal has become more visible, and it is thought that a trend of social pressure has been brought about.

Keywords: body, hair, self-care, hygiene, stigma, survey, social pressure

Which Way is More Reasonable!? ～Comparison of Auction Methods by Using Game Theory ～

Utana Fukuda

Abstract

The purpose of this project was to investigate whether the assumption of the revenue equivalence theorem breaks down in each situation, causing advantages and disadvantages for each auction method. In this study, I compared the 1st and 2nd price auctions from two perspectives: strategy-proofness and risk aversion. First, when examining strategy-proofness, I compared the gain from changing the bid price as [one's evaluated value] - [actual bid price] = [gain]. In the 1st-price auction, since it is more profitable to change the bid amount with a strategy, it becomes a loss to honestly give one's evaluated value, and strategy-proofness doesn't exist in the 1st price auction. In contrast, in a 2nd-price auction, there is no reason to change bids with a strategy, so it can be called a "profitable auction" with strategy resistance. Next, let us consider risk aversion. The assumption of the income equivalence theorem, "risk neutral," was reversed and it was assumed that "auction participants are risk averse". The result is that in the case of 1st-price auctions, they will bid higher prices to increase their probability of winning the auction, even if the price they pay is higher. In contrast, in the 2nd price auction, buyers do not have to bid unnecessarily high prices to win the auction. Therefore, the amount of money that the buyer is willing to pay is higher in the 1st Price Auction, and thus the 2nd Price Auction is more of a good deal.

Keywords: auction, math, theory, strategy, revenue equivalence theorem

GOAT Gotta Go to Get a Goal

Shioh Kuwahara, Kei Miura, Sota Hanada

Abstract

The purpose of this project was to increase the number of goals in soccer games. We took two experiments. First, we examined the correlation coefficient between the goals and the effective plays. Second, we collected some data about the situations when each goal was scored by watching videos of official J-league YouTube channel. The first experiment showed that the correlation coefficient of penetrating 30 meters line and penalty area has almost the same number of points. We thought there were 2 main factors which we should focus on to get more goals. One is penetrating the 30 meters line more, and the other is getting a goal more efficiently in the Penalty Area (PA). Second experiments showed that 93 goals out of 345 were scored from passes, which is much more than we expected, and 49.28% of goals were shot from the center of the PA. We think from this result that it is important to improve the accuracy of the passes and to bring them to the center of the PA many times.

Keywords: soccer/ football, sports, theory, sports analysis

Can a Moving Circle Fill the Space?

Ryo Tanaka, Taichi Wada

Abstract

The purpose of this study is to find the parameter that determines when the trajectory of a moving object fills the space most efficiently according to a specific algorithm. We were inspired by the movement of a cleaning robot and conducted our experiments using a program assembled on Python. We created a program in which a circle moves straight through a room at a constant speed and rotates a fixed angle when it hits a wall. the area of the circle's trajectory after drawing the trajectory 10,000 times was measured from 1° to 180° using the degree method, changing the set angle every experiment. The area was calculated in python by making the image monochrome and calculating the percentage of the room that was occupied by the area of the circle. The room was assumed to be square and free of obstacles. The results were completely different depending on the angle. However, when focusing on the number of common divisors, the more common divisors between the set angle and 360, the smaller the area covered tended to be.

Keywords: special analysis, automation, python, trajectory, efficiency

Odd Sprout Can Spread ～Artificially Creating Strange Shaped Pea Sprouts～

Kouki Sigematsu, Taiki Yanai, Ema Wakaki, Sato Takashima

Abstract

Our purpose was to make specific branching by injuring the pea sprouts, like the clover changing a three-leaf into a four-leaf when the original of the leaf is injured. We experimented with two positions of injury, one at the growth point and the other at the origin of the leaf. First, we experimented with injuring the growth point. Since there are two growth points of pea sprouts, we combined them and experimented with four different ways of injuring them as follows. Of the two growth points, the upper one is growth point (1) and the lower one which is closest to the root is growth point (2). The four different combinations are as follows. Do nothing, injuring only growth point (1), Injuring only growth point (2), Injuring both growth points (1) and (2). Next, we conducted an experiment to injure the original stem. As a result, the relation between the growth point and the occurrence of branching at the top is weak. On the other hand, there was a strong relation between the original stem and the occurrence of branching. Therefore, we considered that the specific occurrence was caused by the original stem.

Keywords: mutation, plants, environment, branching, pea sprouts

Experiments on the Effects of Acid Rain with Moss

Momoha Shimosaka, Misaki Nakamura, Mayuko Isoda

Abstract

For the experiment, we used mosses that are sensitive to their surroundings, nitric and sulfuric acid from acid rain, and aluminum nitrate, which is created by dissolving aluminum ions in the soil. We prepared a total of 24 moss colonies in petri dishes. Nitric acid at pH2, pH3, pH4, and pH5; sulfuric acid at pH2, pH3, pH4, and pH5; and aluminum nitrate at pH3, pH4 and pH5 were dripped onto them. The amount of each drop was 20 ml and the moss was slightly soaked. The moss was not exposed to direct sunlight, but it was exposed to air, so that the conditions other than the drops were the same. A week or two after drops were added, we checked the mosses. The results showed that the moss did not die at any pH with sulfuric acid and nitric acid, but it did die at any pH with aluminum nitrate. The percentage dead tended to be greater in the smaller moss colonies. From these results, it can be said that aluminum ions are a major factor in the effect of acid rain on plants. Moreover, the size of the moss colony also has something to do with it. In the future, we will adjust the size of the moss colony and search for substances that easily bind to aluminum to prevent aluminum ions from affecting plants.

Keywords: environment, ecology, environmental science, moss, acid, plants

Production of Paper Using Biological Methods

Anri Ito, Rio Kakoi, Ai Makino

Abstract

The purpose of this experiment was to make transparent paper by burying materials in soil and using microbial decomposition of fibers without relying on chemical methods, and to compare the transparency and strength of those that were not buried. As paper materials, persimmons, apples and banana peels are used. Some were used as they were, and the rest were buried in the soil for 2 weeks. First, we boiled them for 10 minutes, blended them 15 times with a mixer, strained them with stockings, boiled them into a paste, then we spread the samples on aluminum foil, and dried them to become paper. This process was repeated and compared with the unburied part and the buried part. We succeeded in making paper with each fruit. However, by burying it in the soil and disassembling it, the color became darkened or brittle, so it was difficult to compare the paper. In particular, the banana skin buried in the soil of experiment 2 was like black charcoal when it was dug out, and when it was made into paper, it was black and hard, and it collapsed easily. It didn't seem to work as paper. We thought that the amount of moisture contained in each fruit is different, and it is difficult to equalize the thickness when spreading it on aluminum foil, so we thought comparing each paper was a problem. The fibers may have become soft and fine by burying them in the soil, but the decrease in strength and darkening due to decay were severe, and it was difficult to proceed with experiments by comparing the transparency of the paper, so it is considered necessary to compare from another perspective. In addition, due to the decomposition by microorganisms, the substances responsible for the bonding between fibers may also have been decomposed.

Keywords: upcycling, paper alternatives, fruits, transparent paper, microbial decomposition

ZEBRA-FISH MEMORIES

Soto Yamada, Hina Watanabe, Mikoto Kitaguchi, Jisei Funakoshi

Abstract

The purpose of this experiment was verifying the zebrafish's memory methods, capacities, and abilities to process new information by using color and electric shock. We put water and 9 zebrafish into a water tank. Tablets are placed on both sides of the tank. We showed color with these tablets. Also, we put in carbon rods for flowing electricity. We set the color pattern and the color that flows electricity. In pattern 1, red and blue are shown, electricity being delivered on the red side. Pattern 2, blue and green, electricity on the blue side. Pattern 3, green and red, electricity on the green side. We went through three stages. In the first stage, pattern 1 was executed, and electricity was passed 10s after the color was displayed. In the second stage, we implicated pattern 1 and 2. We conducted pattern 1, 2, and 3 in the third stage. When zebrafish memorized the color to avoid the electricity shock, we moved to the next stage. At the same time, we showed the colors on different sides, and we confirmed the zebrafish's color recognition. We did these experiments on weekdays. Also, we are currently getting results up to the second stage. Zebrafish showed avoiding action in the first and second stage. The data demonstrates that Zebrafish strongly associate traumatic experiences with memory. Also, they can avoid danger even if the situations were changed.

Keywords: zebra-fish, conditioning, trauma

Smile Rush
~Blooming Big Sun Flowers~

Mio Utsugi, Remi Shirasu, Mayu Nose

Abstract

The purpose of this project was to determine which conditions were most appropriate for growing the largest dwarf sunflower, Smile Rush. The pots were filled with 600 ml of soil for the large pots, 300 ml for the medium pots, and 150 ml for the small pots. In each pot, three seeds were placed in each of the three large pots. Three of the medium and three of the small were placed in the vats, making two sets of these. One of these sets was grown in an artificial climatic chamber set at 23.5°C. The other set was grown near a window. Watering was done almost every day, and on days when watering was not available due to holidays, the vats were watered the day before. The plants were measured and compared in three aspects: plant height, stem thickness, and petal size. Height was defined as the length from the soil surface to the growing point. Measurements were taken weekly and compared graphically. The plants grew both in the window and in the artificial weather chamber, but they grew faster in the window, especially in the middle pot, which was the largest. As the hypothesis that plants grow larger at temperatures above 25 degrees Celsius, the plants also grew larger near the window. In the beginning, the large pots grew larger in terms of both stem height and maximum leaf size, but in the middle, contrary to the hypothesis, the medium pots grew larger. The leaves of the plants that grew on the windowsills were smooth and straight, while the leaves in the arboretum were wrinkled and curled outward.

Keywords: sunflowers, environmental science, agriculture

Planarians' Negative Phototaxis with One Eye

Hidenori Ikeuchi, Yuya Okamoto, Chuya Domyo, Genki Matsura

Abstract

The purpose of this research is to contribute to the latest research by approaching planarians from a perspective other than their regenerative abilities. Planarians have negative phototaxis, which means that they identify the direction of light by shaking their heads from side to side and move in the opposite direction. The research focuses on whether negative phototaxis, which has been confirmed in both eyes, can also occur in only one eye. We hypothesize that planarians with one eye may turn in the direction without an eye. First, we tested whether the negative phototaxis behavior is exhibited in normal planarian. We put a planarian in a petri dish which was half covered with black construction paper and put the petri dish in the dark. Then we lit up the petri dish and record this experiment by our smartphone for 20 minutes. We did it 6 times. Second, we gouge a planarian eye so that they only had one eye remaining to check the hypothesis. We put a refrigerant, paper filter, and a planarian in that order on the binocular stereo microscope and cut the planarian's left eye by using a needle and a tweezer. We did the same experiment as before. We also experimented with varying light intensity. The experimental group showed that planarian with both eyes spent less time in the light than planarians with one eye. Planarians exposed to intense light, spent less time in the light. The data indicates that planarians with both eyes have negative phototaxis, but planarian with one eye do not have negative running. We also considered that the degree of negative phototaxis varied with light intensity.

Keywords: planarians, biology, zoology, eyes, phototaxis

iCool ~Cool Down iPhone, Get Higher Performance~

Takuya Yoshioka, Kosuke Munezane, Sota Miyaoku, Koei Higashi

Abstract

The purpose of this study is cooling the iPhone down in an effective and power-saving way to extract higher performance. In the first experiment, three back panels of an iPhone were heated to 50℃ by dipping it into hot water. They were left in three conditions. The first is with nothing attached. The Second is with a heat sink attached. The third is with a heat sink and fan attached. For each case, we observed temperature changes. In the second experiment, a heat sink and fan were attached to the back panel of the iPhone6. The back panel was heated by a Peltier element attached to the inside of the back panel while the fan was rotating. Heating was stopped when the surface temperature reached 40℃, and the temperature was measured every 30 seconds with an infrared thermometer. From the first experiment, the cooling speed was faster in the following order: with a heat sink and fan attached, with a heat sink, and a with a fan attached. Heat sinks alone are effective in cooling, but they are more effective with a fan. From the second experiment, it was found that making air blow on the back panel is more effective than making air blow the other direction. Onto the results of the first experiment. Because cooling efficiency is proportional to the contact area and temperature difference between the solid and fluid, we attribute the result to the fact that the fan allowed the warmed air to escape, thus increasing the temperature difference and thus the efficiency. As for the results of the second experiment, we think it is because when the fan is making air blow on the back panel, there is no resistance to externally circulating air, while when the fan makes air blow internally, the back panel prevents the fan from circulating the air. When using a fan, some space is necessary behind the fan.

Keywords: phones, cooling, engineering, heatsink, fan

Dandelions' Longevity of Floating

Haruki Hamaguchi, Yu Asaga, Yuta Kurumiya, Kimito DeVries

Abstract

The purpose of this study was to research the airtime of dandelions by changing the structure of the fluffs. The reason why we started this study was that we had learned that the structures of organisms in nature are sometimes used in human society. For example, the shape of the top of a bullet train was conceived from the beak of a kingfisher, and Velcro was born from the shape of a burdock fruit. We thought that the mechanism of flying dandelions can be used in our daily life and society, so we started these experiments. In our exploratory experiments, we measured the length of natural Dandelion's beak and seeds, and the airtime it takes to fall 70 cm. The beak is the connection between fluffs and seed. Dandelions only grow in spring, so we first made three fluff models, whose beak lengths are 35.5 millimeters, and the sizes of fluff are small, medium and large. Second, we also made two models, whose sizes are medium and whose beak lengths are 26.63 millimeters and 17.75 millimeters. Third we pressed the pappus of II and III to make them the same size, small. We dropped them from a height of 70 cm with tweezer in a acrylic pipe and measured the airtime. According to the first models, the natural dandelion shape was found to have the longest airtime. From the second models, we could not get any information because there was no relationship, so we should do more experiments. The results of third models are not as expected because the pappus that we pressed became its original shape little by little while we were conducting the experiments.

Keywords: dandelions, flight, airtime, biomimicry

How Great Sound Power Generation
~ Using a Piezoelectric Sensor ~

Keiichi Tanoue, Rio Shiomi, Yuki Takashima, Aoi Hashimoto, Kazuki Mokutani

Abstract

The purpose of this project was to reveal the relationship between the amount of generated power and the incidence angle of a sound wave. We varied the frequency of a sound wave from 100Hz to 650Hz by 10Hz using a USB speaker (MM-SPU7BK, SANWA SUPPLY INC.) connected to a PC (PC-VRT16FBGS3R7, NEC Corporation). Then we irradiated a sound wave to a piezoelectric sensor (LDT0-028K, Measurement Specialties, Inc.) attached on a polystyrene foam board cut into a 20cm square in each case. This operation was repeated three times, and all the data of the amount of electric power generated when each sound wave, which had different frequencies, were registered by an oscilloscope (DCS-1072B, TEXIO TECHNOLOGY CORPORATION) and saved in CSV format. They were organized by 'Microsoft Excel.' The graphs made by the data taken in 'Excel' showed the maximum amount of generated power was registered when a frequency of a sound wave irradiated was 310Hz and there are some waves after that. They demonstrate that varying the incidence angle of a sound wave did influence its frequency, which caused a peak of the amount of generated voltage other than the single peak at 310Hz and the natural frequency of this object system composed of the piezoelectric sensor and the polystyrene foam square was 310Hz.

Keywords: sound, vibrations, Hz, frequency, power generation, piezo electric sensor

The Destiny of Slime ～ Weissenberg Effect ～

Nobutaka Kato, Saki Kondo, Haruto Odagaki, Nanami Kakuhama, Ryo Saida

Abstract

The purpose of this research was to determine the relationship between crosslink density and the normal stress on the slime. We made the slime by mixing 25ml of PVA and 50ml of water together and adding borax saturated aqueous solution (BSAS). We conducted the following experiments, the amount of BSAS varying from 2%, 3%, 4%, and 5% in volume. We put the slime in the beaker, and also stuck rod-1 attached with an electric motor inside the beaker. Then, we flew 2A of electric current into the motor, and turned the motor around. We measured the angular velocity of the rod every 0.02 seconds. Also, we changed the depth of immersion, 5mm, 10mm, 15mm, and 20mm, and conducted the same experiment. We made the graph of the angular velocity. When compared by the amount of BSAS added, the amplitude of the graphs was larger in this order: 3%, 4%, 2%, 5%. Also, when compared by the depth of immersion, the angular velocity was higher in this order: 2%, 3%, 4%, 5%. Through this data, we were able to assume that viscosity is not proportional to the crosslink density of the slime, which is against our hypothesis. Also, since the amount of slime rolled up was inverse proportional to the depth of immersion, we found that the deeper the depth of immersion is, the smaller the normal stress will be.

Keywords: slime, Weissenberg effect, physics, crosslink density, stress

The Mystery of Clapping ~Seeking Better Clapping~

Takuma Tsuji, Junpei Kimura, Shunsuke Maeda, Towa Aoki

Abstract

We wanted to uncover the mystery of clapping, so we paid attention to the speed of clapping and the size of the hands and looked for the relationship between the air pressure, the amount of air, Hz and sound volume. In our experiment, we prepared three wooden cube-shaped boxes (each box's one side is 15cm, 17.5cm, and 20cm) and many balloons. We measured the sounds by placing balloons in a wooden box at a distance of 2 meters from a directional microphone connected to a PC and popping them with a toothpick. Only those balloons whose loudness exceeded 500 in relative value were measured by an application named Wave Spectra Ver, 1.40, leaving environmental sounds out. 15cm, 17.5cm, 20cm square boxes were filled with different amounts of air using a pump to check the correlation. The results are as follows. When changing the size of the box, there weren't any correlations shown with both its frequency and volume. When increasing the pressure of air in the balloon, the volume of the explosive sound became bigger, but we couldn't find any correlation with its frequency. By the results, the faster you clap, the bigger sound you will make, but we couldn't find other relationships. Although we found some relationships from the data, there is so little data that we couldn't find the reason why the characteristic sound is emitted. In this experiment, we could only treat above 500 in relative value. Sounds below 500 might have something to do with sounds of clapping, so we are going to treat sounds below 500 and take the data more accurately. In the future experiment, we will actually clap our hands and compare our experiment's data and real clapping.

Keywords: balloons, sound, clapping, volume, frequency

Development of Fire Fighting System Using Sound Waves

Takuma Matsuda, Yoshitaka Hiraoka, Tomoki Konaka, Akitaka Matsuki

Abstract

The purpose of this study was to determine the best sound wave frequency for firefighting. First, we observed the candle's fire with sound coming directly from the speakers, however, there was not much change in it, so we attached a container to the speakers to collect sound waves. Second, we moved the candle away from the speaker by five centimeters and observed it while changing the frequency of the sound. We took the average of 10 data points. We hypothesized that the higher the frequency, the easier it would be to put out the fire. In result, the fire was not extinguished at frequencies above 80 Hz and below 40Hz. The sound at 55 Hz showed the highest firefighting performance. While doing this experiment, we found that wind was generated at the end of the metal container, so we measured the wind speed while changing the frequency of sound. As a result, the wind was fastest when 55 Hz was given, but the difference in wind speed was quite small, so we concluded that it is not clear from this experiment whether 55 Hz has the best firefighting performance. In conclusion, from this experiment, it is considered that firefighting performance is high at low frequencies, but we think if the frequency is too low, the firefighting performance won't be high. The reason for the highest fire-extinguishing performance at 55 Hz is considered to be that the natural frequency of the steel container was close to 55 Hz, or sound waves caused the change in air density creates areas of high or low oxygen concentration. At low frequencies such as 55Hz, the fire was put out because it spent more time in contact with low oxygen concentration. As a future prospect, we would like to find out if 55 Hz has high fire extinguishing performance regardless of the container material.

Keywords: sound, frequency, firefighting, experimental methods