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Comparing Of Moisture Absorption Between Silica Gel and Herb Gel from Reaction Of Sodium Alginate And Calcium Lactate with Fingerroot, Garlic, and Bergamot

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Abstract:

The purpose of this study is to compare the efficiency of water absorption between silica gel, which is currently available on the market, and three different types of herb gel. Moisture-absorbing materials such as silica gel are widely used in our daily lives. It's something that's been around for quite a while in the industry. Our group hoped to be able to enhance and improve this characteristic by using a more natural ingredient. As a result, our objective for this project is to develop a product that uses local herbs rather than silica gel to make it more environmentally and safely. Putting it to the test and comparing the results to see how effective it is. This study's experiment is divided into five parts. To begin, we used a single piece of bread as the control group. The second component of this study involves putting white non-indicating silica gel on a piece of bread. From the third to the fifth portion of the experiment, we placed three different varieties of herbal gel on a piece of bread on each plate. Furthermore, the results of our experiment show that utilizing herb gel instead of silica gel is a viable option. They both obtained the same outcomes and were equally effective. Bringing our experiment to a successful conclusion. We may then expand the use of the product we've developed to build a superior moisture-absorbing solution that can be used with real-world products and materials.

Keywords: moisture absorption, silica gel, herb gel, bread.

Introduction:

Moisture-absorbing substances, such as silica gel, are now used as desiccant, reducing the possibility of moisture and mold damaging the food or item and extending its shelf life. Silica gel (SiO_2) is made from silicon dioxide, a naturally occurring component in sand. It has microscopic particles capable of absorbing large volumes of water.[1] There are three types of silica gel, separated by their color and properties, which consist of white non-indicating, blue indicating, and orange indicating. The blue-indicating silica gel has a high water affinity and contains cobalt chloride ($CoCl_2$), providing the blue color. Additionally, when this silica gel reaches its maximum absorbing capacity, it will change color from blue to pink. When the orange-indicating silica gel reaches its capacity, it changes color from orange with a high content of methyl violet ($C_{24}H_{28}N_3Cl$) to green. However, we believe that this can be improved. Desiccant compounds can be replaced with local herbs, making them safer for users while also assisting and supporting the usage of local plants by farmers. For instance, since Thailand has various types of herbs, such as fingerroot (Boesenbergia rotunda (L.) Mansf), garlic (Allium sativum L.) and bergamot (Citrus hystrix DC.), for instance, they have the ability to prevent heart attack and stroke, cancer,

diabetes, metabolic syndrome, antioxidants, dietary fiber, anti-inflammatory, cure aphthous stomatitis, antifungal activities, and kill bacteria [3-4, 7]. All of them have the property of liquid reabsorption as well, which assists in the reduction of moisture in the product. The herbs stated enable the development of a better product while also benefiting the environment, and innovating the packaging industry to make it safer and more environmentally friendly for consumers. This study will investigate experimentally the absorption of moisture by white non-indicating silica gel, a desiccant with a very high purity level due to its high vapor capacity and an equally high drying efficiency. The hypothesis of this study is that if moisture and humidity can affect bread quality, then pieces of bread placed in four boxes with silica gel and three types of herb gel can keep their freshness for longer than the bread placed in the first box with no moisture absorption gel.Furthermore, if the herbs we use have the ability to absorb moisture and humidity from the air to maintain and prolong the product, their results and effectiveness can be used to replace the silica gel ensuring the success of our experiment. We believe that this product and idea have the ability to transform the industry by providing scientists and customers with a new experience.

Method and Experimental Details:

Sodium alginate (C6H9NaO7), calcium lactate (C6H10CaO6), fingerroot, garlic, and bergamot, are the ingredients for the experiment. Firstly, Fill the pot with water and small pieces of herbs in various amounts, such as fingerroot (Boesenbergia rotunda (L.) Mansf), garlic (Allium sativum L.), and bergamot (Boesenbergia rotunda (L.) Mansf) (Citrus hystrix DC.). After that, add sodium alginate to the herbal juice. Fill a syringe or dropper halfway with the herbal juice and sodium alginate, then drop it into the calcium lactate solution. It will solidify into a gel. Soak the gel for a few minutes in the calcium lactate solution; it will not easily break. Then scoop the gel into plain water to inhibit the interaction between sodium alginate and calcium lactate.

We largely used home measurement equipment for this experiment, such as fingerroot, garlic, kaffir lime, sodium alginate (C6H9NaO7) and calcium lactate (C6H10CaO6), which we purchased from Krungthepchemi Company. After conducting internet searches for medical journals, research papers, and unpublished studies, we decided to utilize these two types of substances. These two food additives were chosen for a variety of reasons. To begin with, sodium alginate (C6H9NaO7) and calcium lactate (C6H10CaO6) are food additives that have been utilized as gelling, thickening, and stabilizing agents in plant gels. Secondly, the substance is easily accessible, as it may be purchased at a stationery store or a chemical product store. Finally, these two drugs offer numerous advantages. Third, not only do these two ingredients help herb gel keep its structure, but they also have a number of other advantages. For example, as a microbial and virus protection product, sodium alginate (C6H9NaO7) has been used to coat fruits and vegetables. Calcium lactate (C6H10CaO6) is also a food ingredient that is commercially produced and used to flavor, firm, or leaven foods. [5-6]. Finally, the chemical reaction between sodium alginate (C6H9NaO7) and calcium lactate (C6H10CaO6) transforms a herb extract solution into a herb gel; if we wait longer, the herb gel will get firmer and stronger.

Methods:

1)Herb gels production stage

At the beginning, fill the pot with 200 milliliters of water and small pieces of each herb, which are fingerroot (Boesenbergia rotunda (L.) Mansf, garlic (Allium sativum L.), and bergamot (Citrus hystrix DC.), then use a thermal extraction method by boiling the ingredients until the temperature reaches 80 degrees Celsius.

Boiling the ingredients at no more than 80 degrees Celsius will maintain the quality of the herbs. Next, add 35 grams of sodium alginate (C6H9NaO7) into the herb extract solutions and stir them with a stirring rod until well mixed. Third, mix 7 grams of calcium lactate (C6H10CaO6) with 200 milliliters of water. After that, suck herb extract solutions by using droppers or syringes and then drop the solutions into calcium lactate solution.

Subsequently, soak the herb gel from the reaction between Sodium alginate (C6H9NaO7) and Calcium lactate (C6H10CaO6) for 40 minutes, so the herb gels will stay in an undeformed state and be difficult to break because calcium particles in calcium lactate (C6H10CaO6) will infiltrate into the herb gels. Then

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scoop the herb gels into 100 milliliters of clean water to inhibit the reaction between sodium alginate (C6H9NaO7) and calcium lactate (C6H10CaO6). Next, desiccate the herb gels by using food-grade paper towels and leave them to dry completely at room temperature. Lastly, place the herb gels into mesh bags.

2)Experimental stage

Initially, prepare 5 slices of bread for quality testing experiments. Put a slice of bread into each container with a transparent lid. The first box containing only a slice of bread will be set as a controlled group. The second contains a slice of bread with a pack of silica gel.

The third contains a slice of bread with a bag of fingerroot extract gel. The fourth contains a slice of bread with a bag of garlic extract gel. The fifth contains a slice of bread with a bag of bergamot extract gels. Next step, place all boxes at a room temperature with the same conditions.After that, observe the change in color, appearance, and smell of the bread in each box every day and then record the results of the experiment precisely.

3)Observation stage

The observations will be made daily for the most accurate results for comparing precisely. The main topics for observation are the color of the bread, the appearance of fungus or any abnormal texture of the bread, and the smell of bread. The important caution is to only do the inhalation experiment when there is no appearance change. Do not smell the bread if the color or texture has changed to prevent fungus or any pathogen from entering the respiratory system.

4)Record the results stage

The record will be made in table form for convenience to compare each experimental group.

Result and discussion:

The experiment's purpose is to compare the efficiency of water absorption between silica gel and three different types of herb gel, including fingerroot, garlic, and bergamot. The dependent variable of this experiment is the results from the observation for 7 days, which are the color, appearance, texture, and smell of pieces of bread in 5 experimental groups, while the independent variable of this experiment is the materials used to make the desiccant (silica gel, fingerroot, garlic, and bergamot). Additionally, the controlled variables are temperature, moisture, desiccant amount in each box, experimental place, and box size. We use the aforementioned controlled variables to ensure that the results will be as impartial as possible. There is 1 control group whose result of changes is shown in box 1 in each table, which is to place a piece of bread alone without any moisture absorption gel, and 4 experimental groups which illustrate the result in boxes 2–5 in 7 tables, which is to test and observe the change of a piece of bread with silica gel and 3 types of herb gel.

Comparing the results from tables 1 and 2, there is no difference in the color, appearance, texture, or smell of a slice of bread in 5 boxes containing different types of moist absorption gel. The result of the third table shows that the first box has changed from mostly white to soft and spongy, but the appearance shows a few green spots, and the other four boxes are unchanged, whereas the result of the fourth table shows that the color, texture, and smell of five boxes are still the same as in the third table, but the appearance of the first box has more green spots and some fuzzy blue spots.

Furthermore, the outcome of the fifth table demonstrates The first box has a sour smell. Furthermore, the result of the fifth table shows that the smell of the first box is sour, and the result of the sixth table suggests that the result is similar to the fifth table. Last but not least, the results of the fifth table indicate that the fuzzy blue spots in the first box get black and larger, whereas the second box, a piece of bread with silica gel, has a few green spots.

In this research, there are two hypotheses: The first is that if moisture and humidity can affect bread quality, then pieces of bread placed in four boxes with silica gel and three types of herb gel can keep their freshness for longer than the bread placed in the first box with no moisture absorption gel. The results support this hypothesis since a slice of bread from box 1 that does not contain the silica gel on days 3, 4, 5, 6, and 7 changes in color, appearance, texture, and smell. It appeared to have some parts that had turned green with fuzzy blue spots, indicating the presence of fungus, while the majority of it was still white and smelled sour. On the same day, a slice of bread from boxes 2, 3, 4, and 5 had not changed. For the second hypothesis, if the herbs we use have the ability to

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absorb moisture and humidity from the air to maintain and prolong the product, the results and effectiveness can be used to replace the silica gel. A piece of bread in each box containing silica gel and three different types of herb gel demonstrates no changes in color, appearance, texture, or smell. As a consequence, the three types of herb gel have the same efficiency as silica gel and can be used instead of silica gel.

There are several errors in this example, including when we mix the sodium alginate (C6H9NaO7) and herb extract solutions using three different types of herbs to form moisture absorption gels, we use droppers or syringes to drop the solutions into the calcium lactate solution (C6H10CaO6). The size of the solution drop is not precise and unequal in certain drops, which might lead to unequal and inaccurate moisture absorption efficiency in each drop of herb gel.

Table 1: DAY 1 (10 FEBRUARY 2022)

TOPICS BOX	COLOR	APPEARANCE AND TEXTURE	SMELL
1	White	Soft,spongy and clean	Nothing changes
2	White	Soft,spongy and clean	Nothing changes
3	White	Soft,spongy and clean	Nothing changes
4	White	Soft,spongy and clean	Nothing changes
5	White	Soft,spongy and clean	Nothing changes

Table 2: DAY 2 (11 FEBRUARY 2022)

TOPICS BOX	COLOR	APPEARANCE AND TEXTURE	SMELL
1	White	Soft,spongy and clean	Nothing changes
2	White	Soft,spongy and clean	Nothing changes
3	White	Soft,spongy and clean	Nothing changes
4	White	Soft,spongy and clean	Nothing changes
5	White	Soft,spongy and clean	Nothing changes

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Table 3: DAY 3 (12 FEBRUARY 2022)

TOPICS BOX	COLOR	APPEARANCE AND TEXTURE	SMELL
1	For the most part is white	Soft,spongy and a few green spots	Nothing changes
2	White	Soft,spongy and clean	Nothing changes
3	White	Soft,spongy and clean	Nothing changes
4	White	Soft,spongy and clean	Nothing changes
5	White	Soft,spongy and clean	Nothing changes

Table 4: DAY 4 (13 FEBRUARY 2022)

TOPICS BOX	COLOR	APPEARANCE AND TEXTURE	SMELL
1	For the most part is white	More green spots and some fuzzy blue spots	Nothing changes
2	White	Soft,spongy and clean	Nothing changes
3	White	Soft,spongy and clean	Nothing changes
4	White	Soft,spongy and clean	Nothing changes
5	White	Soft,spongy and clean	Nothing changes

Table 5: DAY 5 (14 FEBRUARY 2022)

TOPICS BOX	COLOR	APPEARANCE AND TEXTURE	SMELL
1	For the most part is white	More green spots and some fuzzy blue spots	Sour
2	White	Soft,spongy and clean	Nothing changes
3	White	Soft,spongy and clean	Nothing changes
4	White	Soft,spongy and clean	Nothing changes
5	White	Soft,spongy and clean	Nothing changes

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Table 6: DAY 6 (15 FEBRUARY 2022)

TOPICS BOX	COLOR	APPEARANCE AND TEXTURE	SMELL
1	For the most part is white	Have some green and fuzzy blue spots	Sour
2	White	Soft,spongy and clean	Nothing changes
3	White	Soft,spongy and clean	Nothing changes
4	White	Soft,spongy and clean	Nothing changes
5	White	Soft,spongy and clean	Nothing changes

Table 7: DAY 7 (16 FEBRUARY 2022)

TOPICS BOX	COLOR	APPEARANCE AND TEXTURE	SMELL
1	For the most part is white	Some of the fuzzy blue spots turn to black and bigger.	Sour
2	White	Soft,spongy and a few green spots	Nothing changes
3	White	Soft,spongy and clean	Nothing changes
4	White	Soft,spongy and clean	Nothing changes
5	White	Soft,spongy and clean	Nothing changes

Conclusion and suggestions:

We can conclude from our experiment that the herb gel made up of fingerroot (Boesenbergia rotunda (L.) Mansf), garlic (Allium sativum L.), and bergamot (Citrus hystrix DC.) may be used instead of silica gel because it can perform the same function with the same effectiveness. This indicates that our theory was true, and that our experiment and product were a success. Our product would also benefit a large number of people. Starting with the farmers who are responsible for growing the local herbs and assisting them in their profession.It means that the farmers can not only sell their products to herb gel manufacturers and make more income, but also make the local herbs well known. This device can also assist people's lives by employing a safer material to absorb moisture and humidity in their food and everyday items. This product can relieve people from stress about chemical desiccant in their food packages.

Additionally, three different types of herb gel were made by food grade materials which are Sodium alginate ($C_6H_9NaO_7$) and Calcium lactate ($C_6H_{10}CaO_6$), so this type of moisture absorption gel can be easily decomposed than normal silica gel which currently available in the present markets.

Thus, the herb gel can also reduce the amount of toxic waste in our society.

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Future research and investigations can be pursued in various ways. Firstly, the herb gels can be used for other purposes besides absorbing moisture.

Secondly, there may be more research to find other herbs that have the ability to be fungicides as an option to use more suitable. Furthermore, the biodegradable packages that contain the herb gels will be beneficial as well. Last but not least, it would be better to find more natural materials that have the same properties as Sodium alginate (C6H9NaO7) and Calcium lactate (C6H10CaO6) to make the product more organic.

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