2020年度
大学院理工学研究科【環境共生工学専攻】博士後期課程
一般選抜試験(第Ⅱ期)問題

英　　語

開始時刻　午前10時00分
終了時刻　午前11時00分

【注意事項】

1．答案用紙には、氏名を必ず記入してください。
2．配布された答案用紙は試験が終了したら、必ず提出してください（問題用紙は提出しなくてよい）。

1 次の文章を読んで以下の問いに（日本語で）答えなさい。

The past decade (2010-2019) was the hottest on record and five of the top 10 warmest single years have all occurred since 2015, according to reports released by the UK Met Office and the World Meteorological Organisation.

The current Australian bushfire crisis is also the worst on record, having emerged due to a combination of increased average temperature (roughly 1.5°C above the long term average) and a reduction in rainfall.

But can we attribute this to anything more natural than anthropogenic effects? Solar activity, for example, has previously been linked to temperature and is sometimes blamed for climate change. But our new analysis provides evidence for why this isn't the case.

The Sun is the dominant source of energy for the Earth's climate, so quantifying what influence it has had on global temperatures since industrialisation is very important.

Like all stars, the Sun undergoes variations in solar activity, meaning its energy output varies with time. The visible surface of the Sun (which you should never look at directly) is called the photosphere. When imaged, it appears as a white disk which is occasionally blotted by the appearance of sunspots.

These sunspots are regions of intense magnetic fields that restrict the movement of gas and cause it to cool, making these areas appear dark. However, these same intense magnetic fields connect the visible sunspots on the photosphere with active regions we can't see. These are areas of gas thousands of kilometres above the visible surface that are superheated to millions of degrees. Such active regions emit light very strongly in ultra-violet and x-ray radiation.

The oldest and easiest way of approximating solar activity at any given time is to simply count the number of sunspots visible on the photosphere.

The more sunspots, the more solar activity, and hence the greater overall emission of ultra-violet and x-rays. These emissions are largely absorbed by the Earth's atmosphere before they reach the ground, causing heating (although some studies suggest the situation is more complicated).

Like our planet, the Sun also has a magnetic field that extends outwards. The solar magnetic field defines the size of the solar system and can deflect incoming charged particle radiation from space, called cosmic rays.

These cosmic rays have been linked with the Earth's atmospheric chemistry, seeding cloud formation and extreme lightning storms, meaning they affect temperature and weather.

The number of sunspots rises and falls as part of a roughly 11-year solar activity cycle. There are many sunspots – and more associated emissions of UV and X-rays – at solar maximum and few or

even no sunspots at solar minimum.

The solar magnetic field also varies in strength with this solar cycle. It is weakest at solar minimum and strongest at solar maximum. When the solar magnetic field is weak, more cosmic rays can reach the Earth's atmosphere and affect the climate (as well as the radiation environment of space).

Some of the earliest scientific sunspot observations were made by Galileo Galilei in the 1610s. From the 1700s, such observations became more regular. They constitute one of the longest historically continuous data sets in all of science.

The first observed solar cycle (1755-1766) is called solar cycle 1, the next solar cycle 2, and so on. The most recent is solar cycle 24, which officially began in December 2008 and is still ongoing. We are rapidly approaching the next solar minimum, which is expected in the next year or so.

Solar cycle 24 is unusually weak, with a relatively low number of sunspots, compared to previous cycles. The last one this weak was solar cycle 14, which began in January 1902.

If solar activity did play a significant role in recent changes in global temperatures, then those temperatures should have stayed roughly the same or even declined over the last decade.

A paper from 2012 even predicted there would be a 1.0°C decrease in temperatures. Clearly this has not turned out to be the case. The hottest decade on record has coincided with the weakest solar cycle for over a century.

Given this combination of factors, it is rather difficult to defend the position that solar activity is indeed responsible for present climate change without a radical shake up of the understanding of solar physics.

In the graphs below(*), we have attempted to correlate the number of sunspots with variations in global sea surface temperatures (taken from the Japan Meteorological Agency), and global surface temperatures (taken from GISTEMP data).

The top panels show the warming trend and sunspot number over time. Our analysis reveals no significant correlation between solar activity, based on sunspot number, and atmospheric or sea surface temperatures over the last century. The divergence between sunspot number and temperatures is particularly apparent in the most recent solar cycle.

The lower panels(A) show scatter plots of the number of sunspots against temperature, and again no clear relationship is visible. You can work out mathematically how good the correlation is by measuring how close the datapoints are to a straight line.

In such a calculation, a value of 0 suggests the data is random noise and a value of 1 represents a perfect correlation. We got values of between 0.09 and 0.04, which suggests that the variation is

largely due to factors other than solar activity.

When looking at global temperatures, the average value serves as a baseline and any observed difference from this is called a temperature anomaly.

It is clear from the lower panels that increasing the sunspot number has little discernible effect on the global temperature anomaly. If it did, we would see points clustered around a line sloping upwards to the right in each plot.

These observations of the present solar cycle make it very difficult to defend the position that solar activity is ultimately responsible for the world's current warming trend. Instead they fit with the argument that human influences are responsible for a large amount of the recent increase in global temperatures.

While the Sun is responsible for the overall climactic conditions on Earth, there has not been enough of a long-term difference in solar activity since industrialisation to fully explain our current global warming trend.

(*)出典にあったグラフは省略されている。

(https://www.sciencealert.com/these-4-graphs-show-why-we-can-t-blame-the-climate-crisis-on-solar-activity より一部抜粋・改変)

(1) 「solar cycle」とはどのようなものか概略を説明しなさい。
(2) 「solar cycle 24」とはどのようなサイクルか。またその特徴を説明しなさい。
(3) 「sunspots」が多いときと少ないときとでどちらが「太陽活動」が活発か。
(4) 太陽活動が活発であるとき，何が増加あるいは減少し，その増減が「地球温暖化」にどのような影響をもたらす可能性があると考えられているのか，説明しなさい。
(5) 下線部(A)について。この問題では出典にあったグラフは省略されている。このグラフがどのような図であったか，想像してその概略を示しなさい。
(6) 「temperature anomaly」とはどういうものか，説明しなさい。
(7) 太陽活動は地球の気候にどのような影響を与えると，この文章では結論しているのか。簡単に説明しなさい。

2 次の文章は米国特許4144353A "Artificial fish eggs and method of making same" の一部を抜粋したものである。これを読んで以下の問いに（日本語で）答えなさい。

BACKGROUND OF THE INVENTION

Ever since man learned to fish, fishermen have attempted to increase their catch by discovering new and better means to attract fish. Although today's sport fisherman does not rely on fishing skills for his existence, as did early man, he still seeks a bait or lure that will "get them biting" and thereby increase his chances of becoming a successful angler. Often, a fisherman will have his own special, homespun concoction or time worn method to attract fish. However, in spite of the innumerable attempts that have been made, it is an inescapable conclusion that in order to achieve the best results, the fish bait chosen should be as near as possible in shape, flavor, consistency and color to the natural diet of the sought after fish. As a result, many attempts have been made to duplicate the various constituents of a fish's diet in order to successfully lure it to the hook.

The diet of many varieties of fish includes their own and other species fish eggs and as a result, many fishermen use natural fish eggs as bait. This, however, can be relatively expensive and eggs may be occasionally difficult to procure as the amount available fluctuates. Also, at a time when there is an increasing awareness toward conserving our natural resources, the use of live fish eggs leaves much to be desired. It is clear that the stocks of natural fish eggs should perhaps be better utilized in restocking the various streams and rivers rather than be used as bait. The use of natural eggs can, where there are insufficient reserves available to produce new fish stock, contribute to the depletion of our lakes and streams by removing the fish that will ultimately reproduce the new eggs. This cycle can have as its denouement the decimation of our natural resources.

The prior art exhibits numerous examples of attempts to develop an artificial fish egg that has the same consistency, shape, flavor and color as the natural commodity. For example, Mack et al, U.S. Pat. No. 1,045,716 teaches the treatment of tapioca kernels with sweetened water to yield a composition similar to fish spawn. A similar approach can also be found in Noxon, U.S. Pat. No. 1,291,614 which teaches the use of a trout bait comprised of a globule of hydrated tapioca colored to have the appearance of a salmon egg.

Other compositions of artificial fish eggs may include a homogenous gel comprising protein, water and both a toughening and hardening compound, where the protein consists of animal gelatin, animal glue and casein, Humphreys, U.S. Pat. No. 3,421,899. In addition, in Stephen et al, U.S. Pat. No. 3,876,803 the patentee manufactures artificial fish eggs by mixing a gel forming proteinaceous material such as animal glue, fish glue, fish gelation etc. and water at a temperature above the solgel transition temperature of the solution in the absence of a tanning agent. This mixture forms a homogeneous liquid proteinaceous mass which then undergoes further treatment to yield a fish bait with a cross linked exterior surface and a gelatinous body. While artificial fish eggs that approach the consistency and flavor of natural fish spawn are taught in the prior art, the methods involved are messy, time consuming and relatively complex.

BRIEF SUMMARY OF THE INVENTION

According to this invention, there is described an artificial fish egg and the method of manufacture. This egg comprises a grape that has been treated with fish oil to impart to it a fishlike odor. The grapes are added to an aqueous solution of fish oil and the mixture is heated at a temperature in the range of approximately 87°-94° C. When the grapes have acquired the proper flavor they will rise to the surface of the solution where they can be packaged and preserved in cans or jars for future use.

DETAILED DESCRIPTION OF THE INVENTION

The present invention described an artificial fish egg in the form of salmon eggs or roe which are notably similar to natural salmon eggs in shape, flavor, consistency and color and a method of preparing this artificial bait. The artificial eggs also have a skin of suitable strength so that they may be retained on the fish hook while subject to the stress and strains of normal fishing activity. Naturally, it is very important that the artificial egg have this property to prevent loss of the bait. An artificial egg should have a gelatinous consistency in order to duplicate a natural salmon egg. Also in order to more closely simulate the properties of natural fish eggs, it is also desirable to impart a fish-like odor to the artificial eggs.

It has unexpectedly been found that grapes treated in a fish oil, preferably cod liver oil, have a consistency, odor and shape that is similar to natural salmon eggs. While it is possible that untreated grapes may be a successful bait on some occasions, the use of grapes treated by the present methods more satisfactory results i.e. successful catches. While the mere soaking of the grapes in an aqueous solution of fish oil will impart a fish-like odor to the grapes, better results are obtained if the mixture of grapes and fish-oil solution are heated at a temperature approximately in the range of 87°-94° C. If the mixture is not heated to this temperature, harder artificial salmon eggs are produced. It is preferable to treat the harder spawn with ascorbic acid as a preservative. As each of the artificial eggs acquires the necessary odor during heating of the mixture it rises to the surface of the solution.

As natural salmon eggs have various shades of color that ranges from white to pink to red, the addition of red food coloring, usually artificial food coloring, to the aqueous solution will dye the artificial eggs to the chosen shade. If one desires a different color egg such as green or blue to imitate natural fish eggs other than salmon, a different artificial food coloring may be used. Artificial eggs that are also successful may be manufactured by merely treating the grapes with food coloring in the absence of fish oil. In order to enhance the roe's generally translucent appearance a fluorescent dye may be used. While many dyes are satisfactory the preferred dye is one known as Rhodamine B. Examples of various dyes and the method of applying them may be found in Sarich, U.S. Pat. No. 2,932,572, the disclosure of which is incorporated here by reference.

In a preferred embodiment of the invention thirty pounds of the grapes are added to an aqueous solution containing five gallons of water, one ounce of food coloring, one gram of Rhodamine B and one pint of cod liver oil.

The fish eggs need not have only a fish-like odor, as a cheese flavoring has also been found to be successful. In order to impart a cheese flavor to the grapes, cheese, finely chopped, is added to the aqueous solution along with the fish oil. Artificial cheese flavoring may also be used.

It is also preferred that the grapes chosen for treatment be picked at the highest peak of sugar content because grapes harvested at this stage of their development have an inner texture that most nearly approximates the consistency of real salmon eggs. After the grapes are harvested they are stored with their stems for a short period of time at a temperature of approximately 45° F. until they are ready to be processed. Although it is preferred to use Thompson Seedless grapes which have been grown in this manner, virtually any grape, treated according to this invention, will give satisfactory results.

(1) 人工魚卵の作成法を何故開発したのか，説明しなさい。
(2) 既往の人工魚卵作成法としてどのようなものがあるのか説明しなさい。
(3) この目的の人工魚卵に求められる機能はなにか。説明しなさい。
(4) 本特許が主張する新しい人工魚卵の作成法とはどのようなものか説明しなさい。
(5) 具体例としてイクラ（鮭卵）の場合の作成法を説明しなさい。

3 Answer the questions below in English.

1. Describe what facts are displayed in the figure, in details.
2. Give a discussion on the facts or implications given in the figure.
3. Since Dec 31, 2019, the Chinese city of Wuhan has reported an outbreak of atypical pneumonia caused by the 2019 novel coronavirus (2019-nCoV). Show your guess where in the figure the 2019-nCoV is located in the figure and explain why (Note: This question is not testing your knowledge on the disease).