The Mystery of Biological Transmutation

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Abstract

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Abstract

The idea that water can form elements is thousands of years old. The idea that plants can form elements through their life processes is also ancient. These ideas have ranged from mainstream scientific belief to utter absurdity and now these old ideas are being brought together for a fresh new hypothesis. With the modern instrumentation that is now available for elemental analysis, the idea of biological transmutation can be studied with a higher degree of precision than ever before. Instrumentation such as inductively coupled plasma atomic emission spectrometry (ICP-AES) and inductively coupled plasma mass spectrometry (ICP-MS) can accurately measure elements in samples in the parts per billion (ppb) compared to studies of biological transmutation in the 1980's using Flame Atomic Absorption Spectrometry, which measured elements in parts-per-thousand and required

laborious sample preparation with other elements that could cause contamination. This work reexamines the mystery of biological transmutation that has been shrouded in controversy, and provides a new view to the debate.

Table of Contents Page #

The History of Biological Transmutation

The study of biological transmutation can be said to have begun with the Greek philosopher Thales around 600 BC who stated that the origin of all matter is water. It is the nature, the archê, the originating principle (O'Grady, 2004).

Aristotle followed up on Thales' idea of water being the origin of matter. He believed in four elements: Earth, Wind, Water and Fire. He conceived that each of these elements were all made of the same prime matter and that if all things at their smallest part are made of the same thing than any one thing can be turned into another (Gerson, 1999).

This concept of water as the source of matter flowed through the alchemical tradition as can be seen in a 15th century German translation on the preparation of the *prima materia* of metals in which it is stated… "For all metals have their origin in water, and water is the root of all metals" (Banerji, 1986).

The founder of Pneumatic chemistry, Jan Baptist van Helmont, made one notable study in the 17th century that followed up on this idea. He performed an experiment to determine where plants get their mass by growing a willow tree in a clay vase with 200 pounds of soil. After 5 years, he dried the soil and found that its weight had decreased by only 2 ounces: "Water alone had, therefore, been sufficient to produce 169 pounds of wood, bark and roots" (plus fallen leaves which he did not weigh) (Van Helmont, 1648). The current theory of today explains a large proportion of the mass of the tree comes from atmospheric carbon dioxide, which, in conjunction with water, is turned into carbohydrates via photosynthesis.

In direct contrast to this idea, Antoine Lavoisier in 1789 developed the conservation of mass in chemistry.

“We can state as an indisputable axiom that under all conditions, artificial or natural, nothing is created; an equal quantity of matter exists before and after the experiment and nothing occurs outside the changes and modifications in the combinations of the elements” (Lavoisier, 1789).

Though Lavoisier’s view holds today, during his life, the view that plants could make their own minerals was widely held. At that time, the Berlin Academy of Science announced the following scientific competition in 1795, ’96 and ’97:

“Of which type are the earthly materials which are encountered by means of chemical analysis of native grain species? Do they come into the grains as they are found, or do they come into being by means of the life force and brought into growth by the workings of the plant?”

The winner of this competition was the German scientist Johann Christian Carl Schrader who showed that minerals were formed in grains. He sprouted seeds of wheat, barley, rye, and others in an artificial medium of flowers of sulfur (shown to be completely ash free) and watered them with distilled water. Contamination from dust was guarded against. When he compared the sprouted seedlings to the seeds used he concluded that mineral matter had been created (Cuthbertson, 2007)

In 1807, the highly reputable French scientist Henri Braconnot performed similar studies to Schader's when he grew plant seeds on different artificial media such as flowers of sulfur, red lead oxide, granulated lead, pure river sand, and even an organic product; decomposed wood that was extracted with hot water. He concluded that considerable formation of the mineral components had taken place, especially potassium, in experiments with mustard seed and radish, had taken place (Braconnot, 1807).

Bracconot prophesied a return to the science of the theory of Thales, according to him; matter, in all its diversity, should originate by means of fabrication from the proto-water. He believed that not only water, but other elements such as potassium where formed from hydrogen and oxygen (Cuthbertson, 2007).

Another notable study came in 1799 by the French chemist Louis Vauquelin who had just discovered chromium in 1797 and beryllium in 1798. He demonstrated that a chicken fed exclusively on oats laid more than four times as much "lime" (as calcium carbonate) in its eggs and in its droppings as it had ingested with the oats which had been analyzed beforehand. The chickens had to be able to create the calcium; else their own bodies would have been completely depleted. There was, according to Vauquelin, a creation of matter (Kervran, 1982)

One famous opponent to the idea of life transmuting elements was Nicolas Théodore de Saussure, a follower of Lavoisier, who in 1804 published "Chemical Researches of Vegetation". He stood strongly with the standpoint of the conservation of matter and referred all transmutation and creation to the realm of fables. He put special emphasis on the necessity in this field to be absolutely certain, with experiments, that the so-called created matter was not already present in the environment. So he demonstrated, for example, that the presence of silicates in the plant, which were attributed to the life-force, was in reality determined by the amount of silicon in the soil.

Regardless of De Saussure, in 1822, the English physiologist William Prout followed up on Vauquelin's study and found that hatched chicks contain more calcium than was present inside incubating chicken eggs and the shell (Nelson, 2005)

In 1831, the French chemist Choubard reported that young plants (watercress, etc.) contained minerals that had not existed in the seeds (Nelson, 2005).

From 1870 to 1883 in Germany, Albrecht von Herzeele did numerous experiments on a great many species of seed germinated in a dust-free environment with distilled water containing a mixture of two salts. One of the salts always contained the same anion and a variable cation with each experiment. In other experiments, this was reversed: the cation remained the same, and the anion changed. Von Herzeele went a step further than Choubad by verifying a weight increase in the ashes of young plants stemmed from germinating seeds. In 1873, von Herzeele published a book, The Origin of Inorganic Substances, where he showed research proving that plants continuously create material elements (Beardon, 1988).

The point at which the view that pants could not generate matter came at the end of the 19th century when Wiegmann (professor of soil science in Brunswijk) and Polstorff (pharmacist also from Brunswijk) let 28 seeds of *Lepidium sativum* (watercress seed) germinate in distilled water in a platinum crucible that was filled with fine platinum wire. The crucible was placed under a glass bell jar through which circulated a mixture of 1% carbon dioxide. The seeds germinated and grew into small plants until, after 26 days, they began to die. After drying the crucible and its contents, ashing and weighing, Wiegmann and Polstorff obtained 0.0025 grams of ash. The weight of ash obtained from 28 seeds was likewise 0.0025 grams.

From their experiment they drew the following conclusions:

1. Plants can continue living for a period of time on the reserves of inorganic materials present in the seeds from which they came, but that growth stops once these reserves are insufficient for their further development.
2. Plants cannot transmute elements.
3. As the plants were isolated from all unwanted sources of inorganic matter, the quantity that they contained could not be greater than the original amount that was present in the seed (Cuthbertson, 2007).

For the most part, publications in favor of biological transmutation from that point forward were rejected by mainstream science on the basis that they lacked an acceptable scientific explanation, but, in the early 1900's, with the discovery of radioactivity, transmutation became impossible to deny. In 1919, Ernest Rutherford achieved the first forced transmutation. Alpha particles from polonium were allowed to pass through nitrogen gas; when one of those particles struck a nitrogen nucleus, a hydrogen nucleus was ejected and an oxygen nucleus formed (Reeves, 2008).

Later, in 1935 Irene Joliot-Curie (daughter of Marie Curie) won the Nobel Prize jointly with her husband J. F. Joliot for artificial production of radioactive elements through transmutation. According to her "these transformations constitute true chemical reactions which act upon the innermost structure of the atom, the nucleus" (Curie, 1935).

Her husband, J. F. Joliot stated that they performed transmutations of aluminum in two ways. In one, they projected helium at high speeds, in this reaction the aluminum nucleus capturing helium must be transformed into silicon when a proton is emitted with the following reaction....

$${}^{27}_{13}\mathrm{Al} + {}^{4}_{2}\mathrm{He} = {}^{30}_{14}\mathrm{Si} + {}^{1}_{1}\mathrm{H} \qquad \begin{matrix} 27 + 4 = 30 + 1 \\ 13 + 2 = 14 + 1 \end{matrix}$$

When the reaction is done by irradiating a thin piece of aluminum with alpha rays and dissolved in a solution of hydrochloric acid (Fig. 1) a radio-phosphorous is formed and a neutron is emitted (Joliot, 1935).

$$^{27}_{13}\mathrm{Al} + ^{4}_{2}\mathrm{He} = ^{30}_{15}\mathrm{P} + ^{1}_{0}\mathrm{n}$$

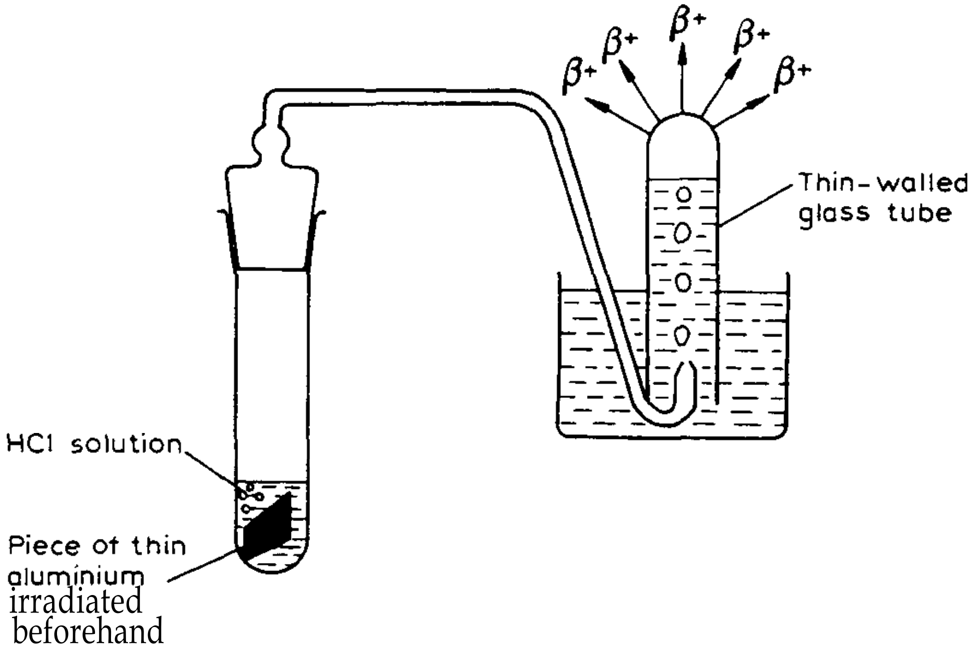


Fig. 1 Apparatus used to transmute irradiated aluminum to radio-phosphorus (from Joliot, 1935).

After the discovery of forced transmutation, which required immense amounts of energy, the idea that plants or living organisms could accomplish the same was forgotten until the 1950s. It was Louis Kervran who developed the concept of low energy biological transmutation. In 1960 he began to publish the first results of his research showing that living matter, both animals and plants, accomplished transmutations of elements. These transmutations were observed in man, animals, microorganisms, and plants.

His most notable experiment came from growing oat grass. In his experiment, he grew thousands of oat and analyzed the minerals using atomic absorption spectroscopy. He found an equivalent increase in calcium to the decrease in potassium (Kervran, 1982). By analyzing the concentration of elements to see if a transmutation was occurring, he found that the total mass of the oat could still be the same, while the composition of the elements changed. This repudiated the second conclusion of Wiegmann and Polstorf who showed that because the total mass of seeds remained unchanged upon ashing them after they grew, no transmutation could have taken place.

Another famous experiment by Kervran followed up on the mystery of calcium in chicken eggs. Kervran believed that the hardness of the chicken eggshell was related to the amount of calcium in it. He found that when he eliminated calcium from the diet of chickens, there was no effect on shell hardness, but when he eliminated potassium, the shell got very soft..

Kervran observed the following transmutation reactions throughout his research:

$Na_{23} + H_1 = Mg_{24}$

$Na_{23} = Li_7 + O_{16}$

$Mg_{24} + O_{16} = Ca_{40}$

$Fe_{56} - H_1 = Mn_{55}$

$O_{16} + O_{16} = S_{32}$

$P_{31} + H_1 = S_{32}$

$Na_{23} + O_{16} = K_{39}$

$K_{39} + H_1 = Ca_{40}$

$F_{19} + O_{16} = Cl_{35}$

$2\ O_{16} - H_1 = P_{31}$

$2\ N_{14} = C_{12} + O_{16}$

$Na_{23} - O_{16} = Li_7$

Kervran inspired a renewed study of biological transmutation across the world. His experiments were analyzed and in some cases replicated. The most thorough study was performed by J.E. Zundel, who spent 13 years of his retirement growing thousands of oat comparing the effects of temperature, light wavelengths, season, and gases. He was fastidious about keeping a controlled environment to not allowing contamination into the experiment. In the course of his experiments, he found a between 50-250% increase in calcium between initial seeds and oat grass while germinating them in bi-distilled water (Zundel, 1980). It is interesting to note that he found a higher transmutation in oats subjected to UV light, because the Pollack lab has seen an increase in the charge separation of water when UV light is applied.

Hisatoki Komaki, founder and Honorary President of the International Earth Environment University, Japan was another collaborator with Kervran who worked with yeast, fungal, and bacterial cultures. He grew them in media deficient in either potassium, magnesium, iron, or calcium. In his research and publications, he observed the following transmutations.

$Na_{23} + H_1 = Mg_{24}$ $Na_{23} + O_{16} = K_{39}$ $K_{39} + H_1 = Ca_{40}$

$Mg_{24} + O_{16} = Ca_{40}$ $Fe_{56} - H_1 = Mn_{55}$

Komaki and Kervran collaborated regularly and published three papers together. They were both nominated for the Nobel Prize (Komaki, 1967, 1969, 1975, 1986, 1992).

Inspired by Kervran, Dr. George Ohsawa sought to transmute sodium into potassium in vitro. Ohsawa and Michio Kushi and their associates constructed an experimental electric discharge tube with copper and iron electrodes and a valve through which to draw a vacuum or admit oxygen (Fig. 2). The first transmutation with this equipment was achieved on June 21, 1964. After applying 60 watts of electricity for 30 minutes to heat sodium to plasma, a molar equivalent of oxygen was introduced. Viewed with a spectroscope, the orange band of sodium gave way to the blue of potassium, according to the formula:

$Na_{23} + O_{16} = K_{39}$ (Kervran, 1982)

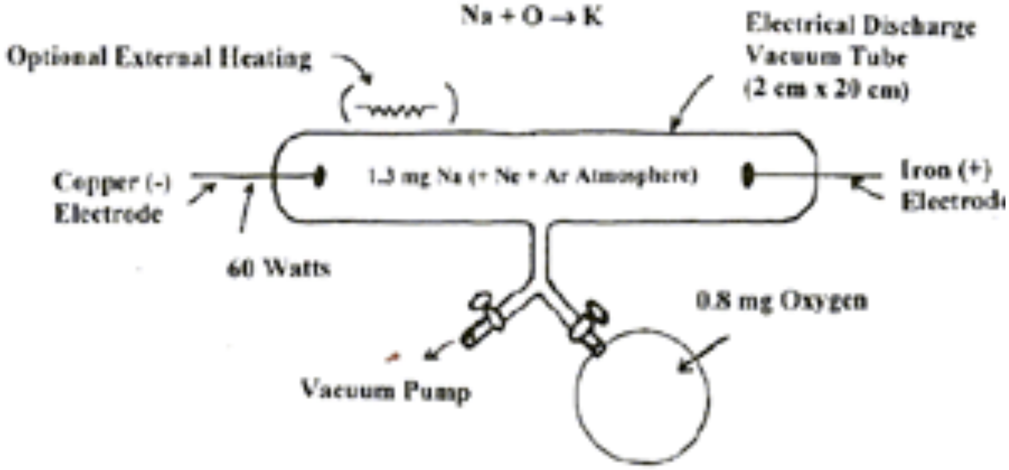


Figure 2. Apparatus for transmuting sodium to potassium from Kervran 1982.

In 1999, Panos Pappas published an article suggesting that biological transmutation occurs as a form of cold fusion in the cellular membrane sodium–potassium pump. According to Pappas (1999), the ions are not pumped back and forth through the membrane, but instead transmute back and forth between sodium and potassium.

Vladimir Vysotskii (2010) has been able to demonstrate transmutation of elements in bacteria in experiments, which give rise to rare isotopes that can be unequivocally identified by spectroscopy. He utilized a bacterium that can grow in D_2O as a replacement for H_20. The bacteria were supplemented with manganese and they produce Fe_{57}. As a control, Vysotskii added Fe_{57} to a culture of the organism and found the transmuting culture exhibited the same spectroscopic band structure as was exhibited by the transmuting culture. The results were also confirmed using mass spectrometry. He also found that if a necessary element is lacking in the bacteria's environment while the raw materials are present, the organism can synthesize a substitute by transmutation.

As an example, Vysotskii found that in the absence of potassium in the medium, bacteria could transmute $cesium_{137}$ into $barium_{138}$, barium being a substitute for potassium. He argues that elements with comparable atomic radius, such as barium and potassium, are significantly interchangeable.

Vysotskii also tried the same experiment using a mixed culture containing thousands of bacteria. This resulted in much greater yields of Fe_{57} with the transmutation continuing on for weeks instead of a few days as was found in the monoculture.

Vysotskii believes this capability to transmute elements includes an extraordinary ability to overcome the so-called Coulomb barrier which is supposed to prevent two positively charged nuclei from coming close enough to interact and form a new nucleus (Vysotskii and Kornilova, 2010).

The Problem of the Coulomb Barrier

The Coulomb barrier is the energy barrier arising from electrostatic interaction that two nuclei need to overcome so they can get close enough to undergo a nuclear reaction.

Protons have positive charge and like charges repel each other like two poles of a magnet. The protons need to overcome this repulsion to have the nuclei fuse. To overcome this barrier, nuclei have to collide at high velocities, so their kinetic energies drive them close enough for the strong nuclear force interaction to take place and bind them together (Mihos, 2012). The strong nuclear force has a very short range of $r<10^{-15}$ m, but once two protons are within the range it overcomes the electrostatic force (Marsh, 2001).

The amount of energy required for two protons to overcome the Coulomb barrier expressed in terms of temperature is 1.6×10^{10} K. This comes out to be about 1000 times hotter that the center of the sun (15×10^{6} K) one of the only known places where fusion does occur. This means that according to the theory of the Coulomb barrier it is impossible for fusion to occur in the sun, but it does (Marsh, 2001).

To deal with this discrepancy, George Gamow came up with the concept of quantum-mechanical tunneling. The basic idea of tunneling is that all matter has a wave nature, and the approach of a nucleus to the Coulomb barrier can be thought of in terms of a wave. With classical physics, when the nucleus' kinetic energy becomes matched by the potential energy of the electromagnetic force it halts, but with a wave it behaves differently. Its character will change from oscillating to an exponential decay, but its amplitude remains finite even when the potential energy exceeds the kinetic energy. It will remain finite the whole way until inside the nucleus. This means that there is a chance that fusion will occur even when the kinetic energy is too small to breach the Coulomb barrier (Marsh, 2001).

Water’s Role in Germination

Germination is the process by which plants, fungi, and bacteria emerge from seeds or spores, and begin their growth. Germination is the beginning of the plant life cycle. The seed starts in a dormancy cycle that is controlled by desiccation. In this first step to pass from an inactive state to an active one, the seed requires water to mobilize the storage molecules and to provide energy (Butnaru, 2010).

Water is required for germination. Mature seeds are often extremely dry and need to take in significant amounts of water, relative to the dry weight of the seed, before cellular metabolism and growth can resume. Most seeds need enough water to moisten the seeds but not enough to soak them. The uptake of water by seeds is called imbibition, which leads to the swelling and the breaking of the seed coat. When seeds are formed, most plants store a food reserve with the seed, such as carbohydrates, proteins, and lipids. This food reserve provides nourishment to the growing seed. When the seed imbibes water, hydrolytic enzymes are activated which break down these stored food resources into metabolically useful chemicals.

After the seedling emerges from the seed coat and starts growing roots and leaves, the seedling's food reserves are typically exhausted; at this point photosynthesis provides the energy needed for continued growth and the seedling now requires a continuous supply of water, nutrients, and light (Raven, 2005).

Plants require a continuous supply of water. Besides water's pivotal role in photosynthesis and transpiration, water also provides the liquid medium in which all the various reactions occur. Therefore, if any transmutation reactions occur inside plants, microorganisms, or macroorganisms, water will be involved.

An observation that I encountered in reviewing many of the proposed biological transmutations is that many of the reactions involved either the addition of hydrogen or oxygen. If water is involved in the transmutations, then maybe it could provide either the H or the O. From research in the Pollack lab into the fourth phase of water, our current hypothesis is that water forms a liquid crystal phase where all the electrons form a region called the exclusion zone and the protons form in a region outside of it. The proton-rich region could be a candidate for donating protons for the transmutation.

Preliminary research in our laboratory by Hyok Yoo has shown that the water inside muscle cells is different than normal bulk water in its structure. This may be true for water inside of cells in plants and seeds and if so, then the exclusion-zone phenomenon may be central for biology. The energy driving exclusion-zone buildup and proton production is ambient light (Pollack, 2013). Hence the source of energy driving the transmutation becomes clear.

Hypothesis

1. Biological organisms can transmute potassium to calcium.
2. Water facilitates biological transmutation by acting as a proton donor.

Specific Aims

Specific Aim 1. Recreate the oat-sprouting experiments of Kervran and Zundel that showed biological transmutations occurring.

Calcium has repeatedly shown up through history as an element that can be generated through the life processes of plants during their development and through eggs during embryonic development of the chicken. Kervran first showed that oats can transmute calcium when that is not available during germination and then Zundel confirmed Kervran's results by the following reaction

$K_{39} + H_1 = Ca_{40}$

Specific Aim 2. If aim 1 is successful, then try to identify possible mechanism for transmutation. If aim 1 is not successful, than try to determine sources of error that could have accounted for results of past studies.

The fourth phase of water is a candidate for facilitating biological transmutation because it contains a rich proton region just outside the exclusion zone. The protons in this region or the extra proton in deuterium oxide (D_2O) could be used for transmuting elements.

Methodology

In order to measure elements in plants or other organisms at the parts per billion level, I have developed a methodology based on EPA protocol 3050B "Acid Digestion of Sediments, Sludges, and Soils". The basic idea is that the element contents of seeds of oats or clover are compared to those of an equivalent amount of sprouts that grow from the seeds with no elements added to the system. The elements are analyzed by both ICP-AES and ICP-MS and a comparison is made to see if, on average, any elements increase in concentration as the seed sprouts and if another elements decrease by an equivalent amount. This mass balance approach is simple, repeatable and powerful for determining if any biological transmutation reactions are occurring.

The sprout seeds were purchased from Sprout People on line at http://sproutpeople.org/ The nitric acid was reagent grade and the Nanopure water was obtained from a Barnstead Water System.

A graphic depiction of this methodology is shown in Figure 3. Although oat seeds are used for the example, any seed can be processed with this methodology.

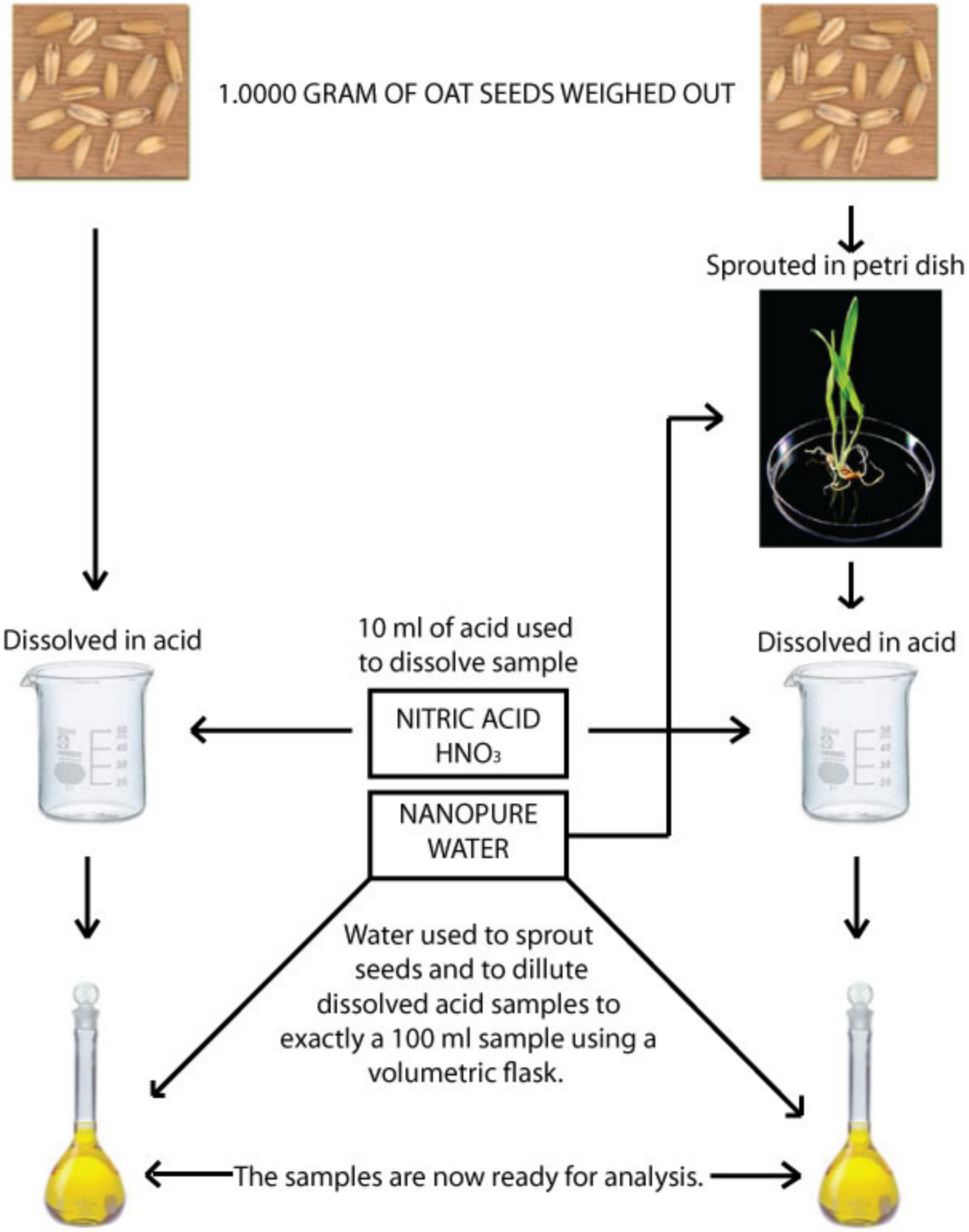


Figure 3. Preparation of seeds and sprouts for elemental analysis.

The steps involved in running this experiment were the following.

Step 1. Twenty samples of 1.0000 gram each of seed were weighed out.

Step 2. Ten of the seed samples are placed in 50-ml beakers that were cleaned with nitric acid to remove any mineral residue on the glass and then washed with Nanopure water. The other ten samples were placed in petri dishes similarly cleaned with nitric acid and Nanopure water.

Step 3. Ten milliliters of nitric acid were added to each of the beakers containing the seeds and they were heated to around 212 ^{o} F till the seeds completely dissolved in the acid.

Step 4. At the same time, 10 ml of nitric acid were added to a clean 50-ml beaker heated without seeds as a control to be used to subtract elements that might have been added from acid, glassware or other sources of contamination.

Step 5. The ten dissolved seed samples and the control were then each poured into a 100-ml volumetric flask. The beakers were each rinsed with Nanopure water two times and the rinses were added to their respective volumetric flask. The flasks were then filled with Nanopure water to exactly 100 ml. The samples were then ready for elemental analysis with an ICP system.

Step 6. The ten sets of seeds in the petri dishes were filled with Nanopure water. The water was topped off each day till the sprouts were mature.

Step 7. The sprouts were prepared for analysis following steps 2-5.

The seeds of oats, clover, mung beans and broccoli were allowed to sprout in Nanopure water that was devoid of elements. The idea is that if the plants were starved of necessary elements, they could transmute the elements that they had in their storage for their necessary life processes until their storage was insufficient for continuing to grow.

Different types of water were analyzed with this method. An experiment sprouting oat seeds in a 10% deuterium oxide/ 90% Nanopure water solution (Figure 4) was performed. The sprouts were then dissolved in hot Nitric acid and diluted in Nanopure water in a volumetric flask to exactly 100 ml as shown in Figure 3 above.

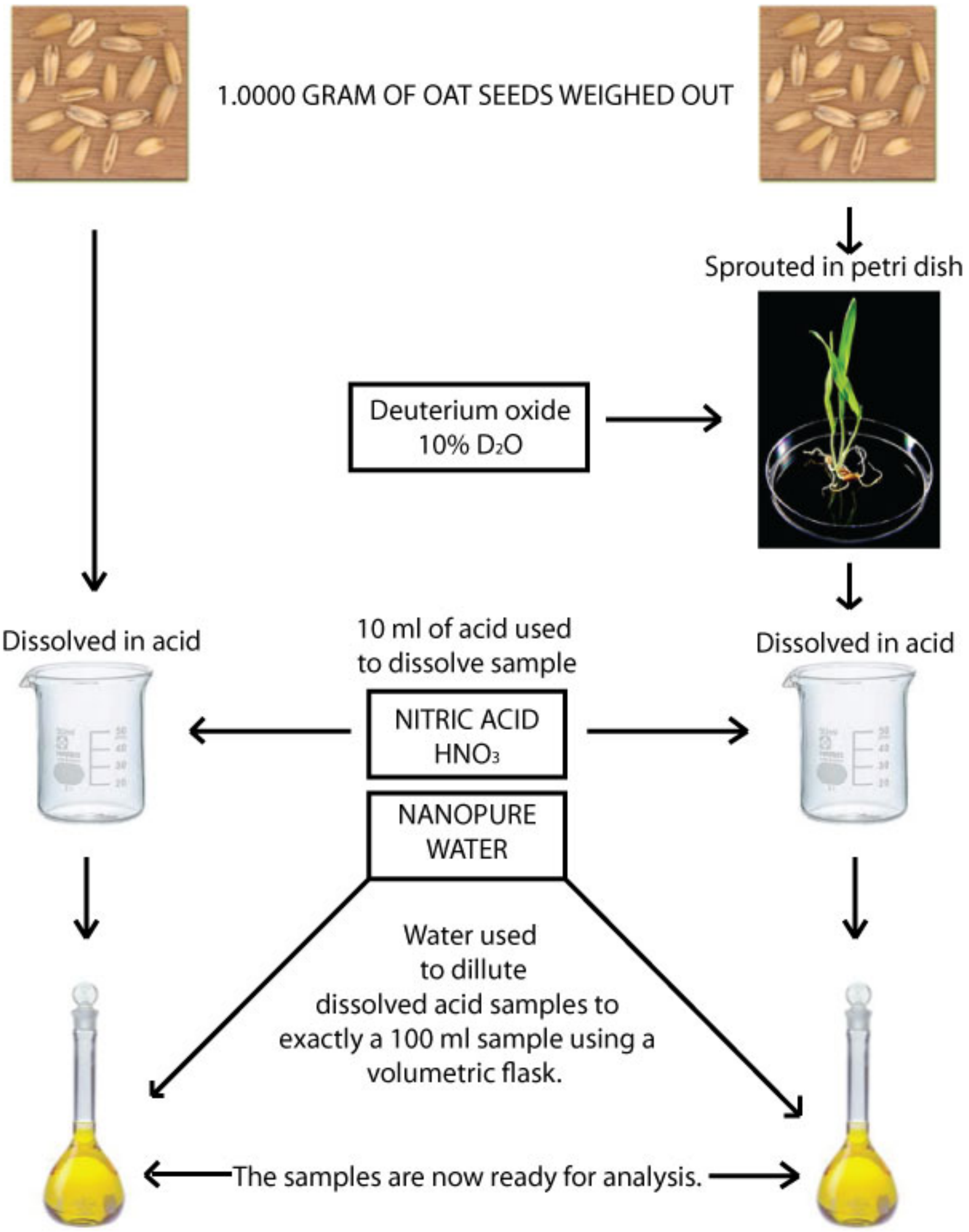


Figure 4. Depiction of experimental protocol watering sprouts with alternative water types. In this example D_20 is used as water source for sprouting.

In some cases, the water used to soak the seeds is collected, such as when growing red clover sprouts. When growing oats, the water evaporates and new water is continually added. Therefore, elements do not leave the system. In the red clover sprouting case, the water used to soak them was analyzed to see which elements were leaving the system and to account for in the mass balance.

Chicken eggs were also analyzed to see if calcium concentrations changed during the incubation period. Fertilized chicken eggs of the same batch number and species where purchased from a scientific egg hatchery. Ten eggs were incubated for 14 days. This time was chosen because it is the longest they can be developed before a spinal cord is formed. At 14 days the eggs were dissolved in nitric acid in the same manner as steps 2-5 above. The 10 eggs were then compared to 10 eggs that were not incubated through elemental analysis.

The chicken egg experiment was also run in another manner. Instead of comparing eggs that were incubated to eggs that were not incubated. All 20 eggs were incubated for 14 days and then eggs that contained a developing chicken were compared to eggs that did not have a chicken in the egg.

The way that the seed and egg prepared samples were analyzed was by both inductively coupled plasma atomic emission spectrometer (ICP-AES) and/or by inductively coupled plasma mass spectrometer (ICP-MS) as can be seen in figure 5.

One powerful analytical tool provided by the ICP systems is the ability to subtract both a blank control and an experimental control from the elemental data generated. The blank control in this experiment was Nanopure water. The experimental control was created by going through the steps shown in Figure 3 with no sprouts or seeds. This meant that any elements that could be brought into the system either from the container, the acid or traces from the Nanopure water were accounted for and subtracted from the experiment.

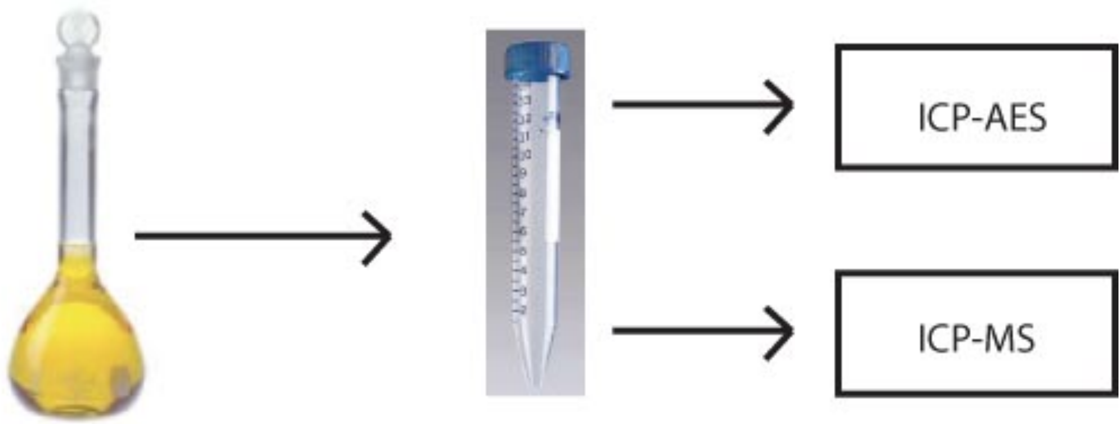


Figure 5. Depiction of instrumentation used to perform elemental analysis.

The data generated from either the ICP-AES or the ICP-MS is in parts per billion (ppb). Since the sample size is exactly 100 ml, it is easy to convert ppb into milligrams (mg) of each element present.

Specific Aim 1

The purpose of the first specific aim is to reproduce the oat sprouting experiments of Kervran and Zundel that showed a calcium increase from 50-250%. Calcium has repeatedly showed up through history as an element that can be generated through the life processes of plants during their development and through eggs in the embryo development of the chicken.

Kervran reported an increase in calcium and an equivalent decrease in potassium. He believed that the following transmutation was occurring:

$K_{39} + H_1 = Ca_{40}$

Seeds grown in a controlled environment in a region of the world without calcium present in the air do not appear to transmute calcium. This is the case with oats (*Avena sativa*), red clover (*Trifolium pratense*), mung beans (*Vigna radiate*), broccoli (*Brassica oleracea*) and chicken eggs (*Gallus gallus domesticus*). There are moments in time where one experiment will show an increase in calcium in sprouts compared to the seeds, but over the long trend there is no difference in the amount of calcium in the seed versus the sprout. The most difficult part of analysis in these experiments is that it is impossible with the current forms of elemental analysis to measure the concentration of elements in one seed before and after sprouting. This has been the case from the initial point in history where elements where compared through ashing the material and relying on accuracy of mass, to the present where samples are now dissolved in acid and their spectrums are analyzed through mass spectrometers or atomic emission.

Therefore, seed samples of the same species with the same germination rates and insurance of no weed seeds are used. The logic is that calcium concentrations in a fixed sample of seeds will remain consistent. In order for this to work, the elemental concentration in the seeds must have a low variance. Unfortunately, in nature, uniformity does not often lead to success and rarely are seeds identical. There are natural fluctuations in the concentration of elements in seeds. This leads to a significant standard deviation. Therefore, if biological transmutation is occurring in noticeable levels within our detection limit, the elements being generated have to be greater than the natural variation found among seeds, which manifest itself in the standard deviation.

In order to overcome the natural variation, the experiment needed to be repeated over a hundred times. The average is taken and the seed versus the sprout is compared to see if calcium noticeably increased after a month of sprouting. The variation in milligrams of calcium in both the seed and the sprout samples ended up being between 0.4 to 0.6 milligrams of calcium. Analogously, the experiment behaved like a random number generator that was set to produce a number between 0.4 and 0.6. After 100 random numbers are selected the result would be predicted to fall around 0.5.

This was basically the result with the oats. After 100 samples had been sprouted and 100 seeds analyzed with each experiment using 10 sets of seeds and 10 sets of sprouts, the average was around 0.53 mg +/- the standard deviation as shown in Figure 6.

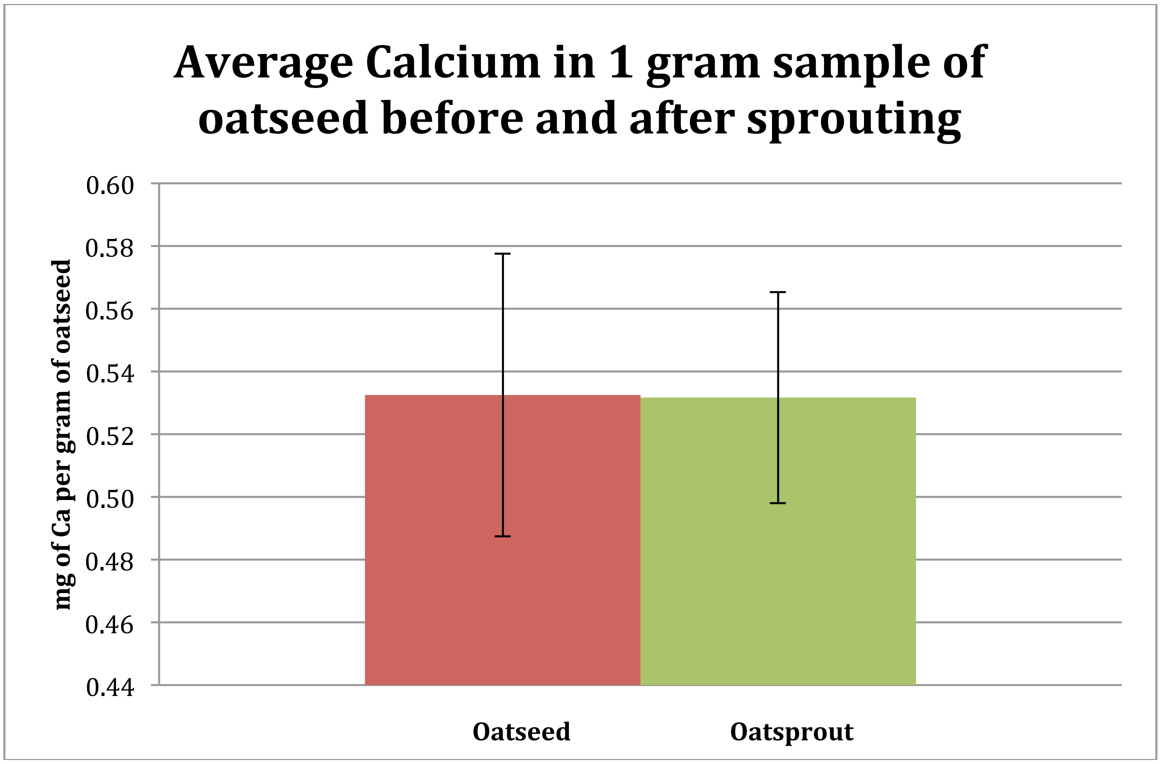


Figure 6. A comparison of the calcium contained on average in oat seed versus oat sprout. (n=100 each)

A sweep of other notable elements that Kervran proposed may transmute was also completed. The following elements were analyzed in all experiments:

Magnesium

Sodium

Potassium

Calcium

Iron

Manganese

Phosphorus

This allowed for analysis of the following possible transmutations:

$Na_{23} + H_1 = Mg_{24}$ $Na_{23} + O_{16} = K_{39}$

$K_{39} + H_1 = Ca_{40}$ $Mg_{24} + O_{16} = Ca_{40}$

$Fe_{56} - H_1 = Mn_{55}$ $2\ O_{16} - H_1 = P_3$

$Mn_{55}+H_1 = Fe_{56}$

As can be seen in Table 1, none of the elements changed significantly on average between seed and sprout beyond the standard deviation with the exception of potassium. The only element that showed a significant change beyond the standard deviation was potassium which decreased similarly to the findings of Kervran as can be seen highlighted in green in Table 1. Potassium exists in higher concentrations than calcium in oat seeds. If all the loss of potassium was assumed to create calcium as Kervran hypothesized, than a large percent increase in calcium would be expected. This study was unable to reproduce the increase in calcium with oat seeds but the loss of potassium is still not fully accounted for.

Element	Oat seed average	Oat seed standard deviation	Oat sprout average	Oat sprout standard deviation	P-values
Mg	2.3516	+/- 0.106	2.44825	+/- 0.252	0.17
K	1.8942	+/- 0.071	1.27425	+/- 0.145	0.01
Ca	0.05325	+/- 0.003	0.05316	+/- 0.007	0.54
Fe	0.02354	+/- 0.009	0.02265	+/- 0.009	0.08
Mn	0.02374	+/- 0.002	0.0252	+/- 0.002	0.32

Table 1. Average milligrams of elements found in both the seeds and sprouts of oats. P-values represent a t-test comparing the oat seed and oat sprout data.

Oats were also grown in Deuterium oxide (D_20) commonly called Heavy water. D_20 differs from regular water because of the stable heavy isotope of hydrogen which contains a neutron making them about twice as heavy as normal hydrogen. This leads to many special properties of D_2O, and when ingested by plants or animals, the "deuterium isotope effect" occurs in which D replaces H in many biological molecules (Kushner et al, 1999). Heavy water is also one of the known substances that affects the period of circadian oscillations. It causes a consistent increase in the length of each cycle. There is some conjecture that the biological clock is somehow based on the size of the hydrogen molecule and as the heavier D replaces H the timing changes, but no one knows the reason for sure (Pittendrigh et al, 1973). The problem is that most organisms cannot handle high concentrations of it in their body. It is toxic in plants above five percent. Humans can handle up to 20%, protozoa can withstand up to 70%, but algae and bacteria can thrive in 100% D_20 (Kushner et al, 1999).

Oat does not thrive in 10% D_20. In fact, sprouting in general was nearly nonexistent. The data generated was abnormal. The milligrams of calcium ranged from 0.0093 to 0.78 and both magnesium and potassium ranged from undetectable to 0.02

In an effort to test other sprouting seeds and organisms that prior studies have indicated may transmute calcium. Red clover, broccoli, mung beans and developing eggs where tested.

Similarly to oat, red clover is a cover crop used to enhance the mineral content of soil. Because of this, it was selected as a candidate plant for biological transmutation. Initially, red clover showed the most promise for generating calcium. Looking at Table 2, it appears that calcium was slightly increased after sprouting, as well as iron and manganese. The possible elements that could transmute into calcium are potassium or magnesium by the following routes.

$K_{39} + H_1 = Ca_{40}$ $Mg_{24} + O_{16} = Ca_{40}$

Potassium decreased 20-30% in the red clover, which is similar to the percent decrease in potassium with oat seeds versus sprouts. This loss in terms of milligrams was an order of magnitude more than the calcium present in analysis. On the other hand the decrease in magnesium was equivalent to the gain in calcium as can be seen in Figure 8.

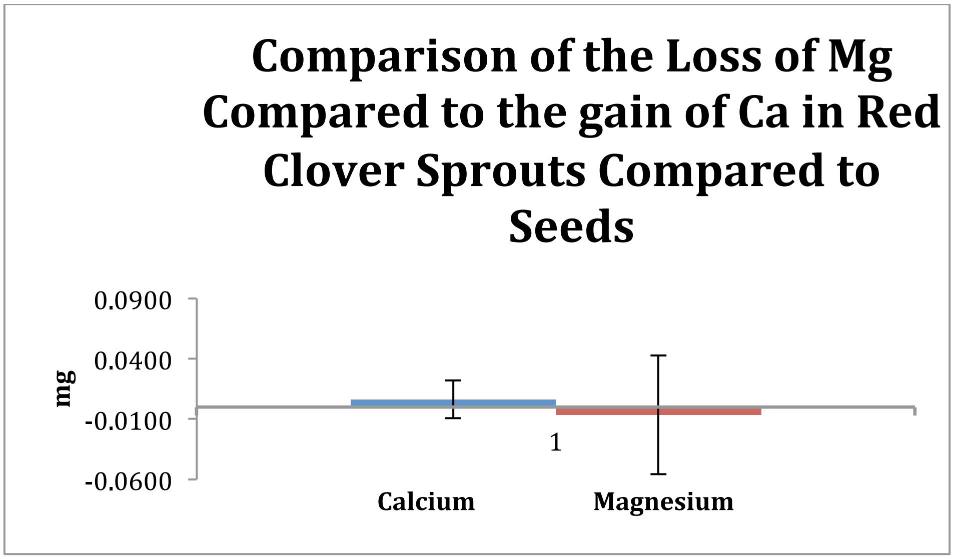


Figure 8. The loss of magnesium was equivalent to the gain of calcium in the sprouts of red clover.

This is an example of how the data can be deceptive. In Figure 8, it appears that the loss of magnesium and the gain of calcium are not significantly different from each other.

This could indicate that an equivalent amount of magnesium is being transmuted into an equivalent amount of calcium. On the other hand, when comparing the natural variation in the calcium content in red clover seeds compared to the mg of calcium found in the sprouted red clover, there is no significant difference between the seed and the sprout as can be seen in Table 2. The only element lost beyond the standard deviation and that has a significant difference between the seed and sprout is potassium again, as highlighted in green.

Element	Clover Seed	Clover Seed Std Dev	Clover Sprout	Clover Sprout Std Dev	P-values
Mg	0.63496	+/- 0.052	0.62848	+/- 0.049	0.85
K	0.43934	+/- 0.057	0.3462	+/- 0.024	0.01
Ca	0.08716	+/- 0.016	0.09346	+/- 0.016	0.55
Fe	0.0055	+/- 0.006	0.01362	+/- 0.017	0.34
Mn	0.0008	+/- 0.001	0.00232	+/- 0.001	0.054

Table 2. Milligrams of elements found in the seeds and sprouts of red clover. P-values represent a t-test comparing the clover seed and clover sprout data.

Similarly to oat, the only element that changed beyond the standard deviation from seed to sprouting was potassium.

Next, mung beans were sprouted. Although they were not cited as a species that generated calcium, Engel and Gruber (2006) showed that when mung beans were supplemented with MnCl the amount of iron present in the sprouts compared to the seeds increased. This made it a species of interest because of the prior experiments. After running this experiment, I found there were significant changes in both manganese and iron and the p-values for both showed that the amount of iron or manganese is different in the sprout and seed, but both elements decreased. This was contrary to the findings of Engle and Gruber that the iron was increased.

Element	Mungbean seed average	Mungbean seed standard deviation	Mungbean sprout average	Mungbean sprout standard deviation	P-values
Mg	3.5526	+/- 0.456	3.037	+/- 0.350	0.40
K	6.3702	+/- 0.869	5.6916	+/- 0.751	0.77
Ca	0.70722	+/- 0.082	0.5954	+/- 0.054	0.16
Fe	0.03824	+/- 0.023	0.01902	+/- 0.009	0.003
Mn	0.0070	+/- 0.001	0.0060	+/- 0.001	0.03

Table 3. Milligrams of elements found in the seeds and sprouts of mung beans. P-values represent a t-test comparing the mung bean seed and mung bean sprout data.

Broccoli seeds were also tested. When contents of elements in sprouts and after one month of growth were compared with those of seeds, there was a loss of both potassium and calcium in the seeds versus the sprouts as can be seen in Table 4.

Element	Broccoli Seed	Broccoli Seed Std Dev	Broccoli Sprout	Broccoli Sprout Std Dev	P-values
Mg	0.60884	+/- 0.059	0.55598	+/- 0.042	0.18
K	0.38032	+/- 0.039	0.23356	+/- 0.024	0.0002
Ca	0.39254	+/- 0.026	0.30354	+/- 0.051	0.014
Fe	0.0065	+/- 0.001	0.01264	+/- 0.014	0.4
Mn	0.00194	+/- 0.0004	0.00134	+/- 0.0004	0.07

Table 4. Milligrams of elements found in the seed and sprout of broccoli. P-values represent a t-test comparing the broccoli seed and broccoli sprout data.

Another organism that showed transmutation of calcium in the literature was chicken eggs. First, Louis Vauquelin (1799), then William Prout in 1822 and finally Kervran in 1982 showed an abnormality in the mass balance of calcium entering the chicken and leaving it in the eggs and droppings or just in the development of the egg itself from fertilization to the hatching of the chick. Chicken eggs are a good system to work with because they represent a closed system that is mostly cut off from outside the egg. Air and heat may be exchanging through the eggshell, but beyond that, element flow in and out should be minimal.

In the first few experiments of incubating fertilized eggs purchased from the same species and batch number, a comparison was made between eggs that successfully developed an embryo with eggs in which no embryo developed. In those initial experiments, there was a significant difference between the calcium found in the developed embryos. There was a 1200% increase in calcium in the developed embryos compared to eggs that did not successfully develop a chicken embryo, as shown in Table 5. In fact, there was a dramatic increase in potassium and magnesium as well. After further review, it was determined that too many other factors may be able to account for the changes in element contents in successful fertilized eggs compared to unsuccessful fertilized eggs. For example, one hypothesis is that the unsuccessful developed eggs did not develop because they were lacking the necessary elements for development.

Element	Fertilized Egg Average	Fertilized Egg Stan Dev	Unsuccessful Fertilization Average	Unsuccessful Fertilization Stan Dev	P-values
K	27.31	3.18342583	0.921	0.852	0.003
Mg	36.5166667	6.73993736	3.2485	0.8825	0.01
Ca	326.333333	58.5865931	25.255	25.255	0.01
Mn	1.00166667	0.40660081	0.895	0.431	0.84

Table 5. Milligrams of elements found in fertilized eggs that have gone through 14 days of incubation. Eggs with a chicken embryo are compared to eggs that did not develop an embryo. P-values represent a t-test comparing the successful fertilized eggs to the unsuccessful fertilized eggs data.

In order to eliminate this potential bias, the experiment was rearranged in the comparison. Again, fertilized eggs were ordered from the same species and batch, and ten eggs were incubated for 14 days and ten eggs were not incubated. Both sets where analyzed for element contents. The amount of elements between the incubated eggs and the non-incubated eggs were found to be the same.

In summary, biological transmutation could not be shown with oat, red clover, mung beans, broccoli, or chicken eggs. Of particular interest was the generation of calcium, but there was no noticeable increase in calcium as reported by Kervran (1982) or Zundel (1980). The one element that repeatedly changed was potassium, which tended to decrease in the sprouts compared to the seeds in oat and red clover. The loss of potassium was identified though in the following specific aim. The potassium leaves the sprout in the water used to rinse it. Since specific aim 1 is unsuccessful, then this leads to specific aim 2: attempt to determine the sources of error that could have accounted for the results of past studies.

Specific Aim 2. If aim 1 is successful than try to identify possible mechanism for transmutation. If aim 1 is not successful than try to determine sources of error that could have accounted for past studies.

Many of the studies surrounding biological transmutation involved the creation of calcium in the sprouting of seeds. Both Kervran (1982) and Zundel (1980) reported increases in calcium upwards of 250%. An attempt to reproduce those experiments in a controlled environment failed to replicate their results. No significant change in calcium was seen.

Therefore, what other factors could explain the large increase in calcium seen by Kervran and Zundel.

Initially, the possibility was that magnesium or potassium was decreased because it was being transmuted to calcium. But, after no success in repeating those results, other possibilities needed to be investigated to see if the change in elemental composition was caused by other outside factors. Eight possibilities for how magnesium, potassium and calcium were being lost or gained were identified and their impact on the system was calculated. These possibilities are:

1. Natural radioactive decay of K_{40} to Ca_{40}
2. Mg, K, and Ca are absorbed from the air
3. Mg, K, and Ca absorbed from Pyrex and plastic
4. Elements are volatilizing in air with evaporating water
5. Mg, K, and Ca dissolve in water and leaving system when rinsing sprouts
6. Trace contaminants of Mg, K, and Ca are entering the system with the Nanopure water
7. Microorganisms are adding elements to the system
8. Instrument error and limits of detection

The purpose of these tests and background research was to determine if the quantities of magnesium, potassium or calcium gained or lost from each of these possibilities were significant and to create a summation of these alternative sources for elemental change to account for them in the mass balances.

Natural Radioactive Decay of K_{40} to Ca_{40}

The first concept to check is if the natural decay of potassium to calcium is significant and causing the biological transmutation. This leads to the first hypothesis:

Hypothesis - K_{40} is decaying to Ca_{40} and is the source of biological transmutation.

Test: Review the calculations for decay of K_{40} to Ca_{40} and determine if this is a significant source of the decrease of potassium and increase in calcium.

Review of Literature and Calculations

Although there are 24 known isotopes of potassium, only three forms occur naturally:

Isotope	% of total K occurring naturally
K_{39}	93.3
K_{40}	0.0117 (radioactive isotope)
K_{41}	6.7

Potassium is in the top ten most abundant elements on earth and comprises about 2.1% of the earth's crust (Likens et al, 1994).

Of those isotopes, K_{40} has a half-life of 1.250×10^9 years. About 11% of the time, K_{40} decays to Ar_{40} by electron capture, but most of the time (89%) it decays to stable Ca_{40} by beta decay (Georges et al, 2003).

Potassium is in the water, soil and all the plants and animals on earth in high quantities and a percentage of that is the radioactive isotope K_{40} (Fritz et al, 2007). In the soil, there is 2.09×10^4 milligrams potassium per kilogram of dirt. Of that .0117% is ^{40}K or 244.5 mg per kilogram of dirt. The ocean also contains abundance with the total potassium content being 3.99×10^2 milligrams per liter. Of that .0117% is K_{40} or 4.67 mg per liter of ocean water. It is present in all the plants and all the food we eat in varying concentrations and, on average, of the 140 grams of potassium in the human body at any time, 17 mg of it is K_{40} with a daily intake of around 0.39 mg (Idaho State University, 2006).

Even though it has a seemingly long half-life consider that all the K_{40} present here was formed when the Earth condensed from the solar nebula. That means that at present there is only 8.4% remaining from the original amount and every second there is a high probability that ^{40}K will decay into Ca_{40} (Asimov, 1955).

In fact in the human body alone, assuming a 70kg person, of those 17mg of K_{40}, 4,433 atoms of K_{40} decay every second. 89% undergoes beta decay and become stable Ca_{40} (Harvard Natural Sciences Lecture Demonstrations, 2014). This means every second in the human body 3945 atoms of calcium are created from potassium.

3945 atoms of Ca * 1mol Ca/6.022 X 10^{23} atoms Ca* 40.078 g/mol Ca =

2.63 X 10^{-19} grams of calcium are created every second in the human body, and

4433 atoms of K_{40} * 1mol ^{40}K /6.022 X 10^{23} atoms ^{40}K * 39.0983 g/mol K_{40} =

2.87 X 10^{-19} grams of potassium are lost every second in the human body

This transmutation is measureable with Gamma ray spectroscopy. The release of beta particles from the decay shows an energy release of 1.33 MeV (Harvard Natural Sciences Lecture Demonstrations, 2014).

The question arises, is this significant enough to make an impact on the changes of calcium observed in the seed sprouting experiments or the chicken egg incubation period? Even though a human contains orders of magnitude more potassium than the seeds of clover or oat sprouts, the concentration of K_{40} is greatly studied and the rate of K_{40} transmutation to Ca_{40} is documented and confirmable by Gamma ray spectroscopy in the human body. Therefore, if a human generates 2.63 X 10^{-19} grams of calcium every second, than in one month, the average time for sprouting experiments, an average human generates 6.82 X 10^{-10} mg of Ca. This number is so small that it will not show up in the ICP system, therefore it is insignificant in the timescale of my experiments. A possibility is that this nuclear decay transmutation could act as a catalyst or start a small chain reaction to assist in a biological transmutation, but that is unknown.

Magnesium, Potassium, and Calcium Absorbed from the Air

Magnesium, potassium, and calcium may be present in molecular or ionic form in the air and may be absorbed by the water and transmitted to the plants or directly absorbed by the plants from the air. Although there is precedence for plants being able to fix elements such as nitrogen or carbon from the air in a gas form, there are no data about plants being able to fix magnesium, potassium, or calcium from the air, therefore, this experiment would just check if Nanopure water can absorb these elements and if the concentrations that are absorbed are significant enough to account for the change in elemental composition.

Hypothesis – Magnesium, potassium, and calcium are increasing during sprouting of the seeds because these elements are being absorbed by the water from the air.

Experiment design – Fill 23 beakers full with 30 ml of Nanopure water and leave open for one month in the lab where sprouts are grown. After the one month grow cycle time, analyze the remaining water to see if magnesium, potassium, and calcium have been absorbed from the air.

Results and Discussion

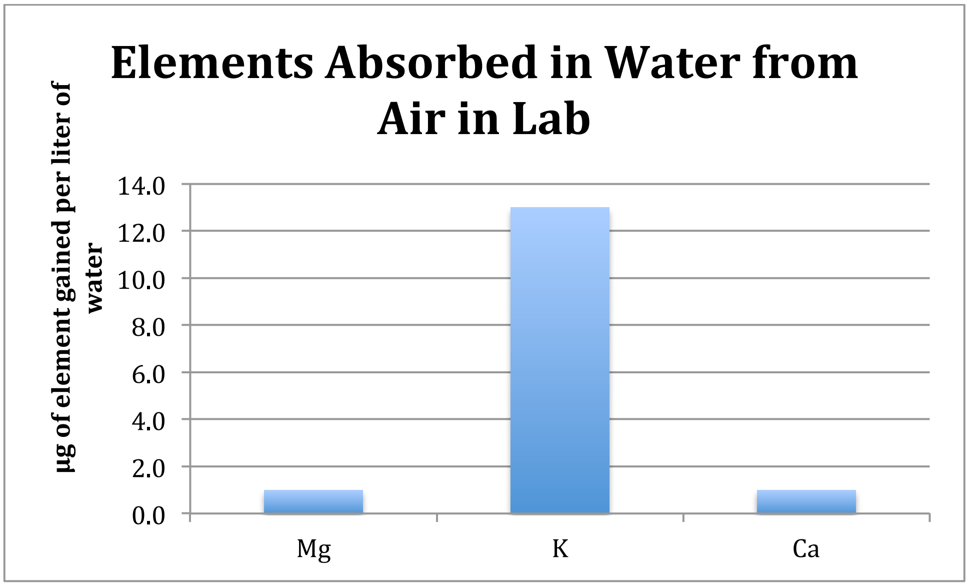
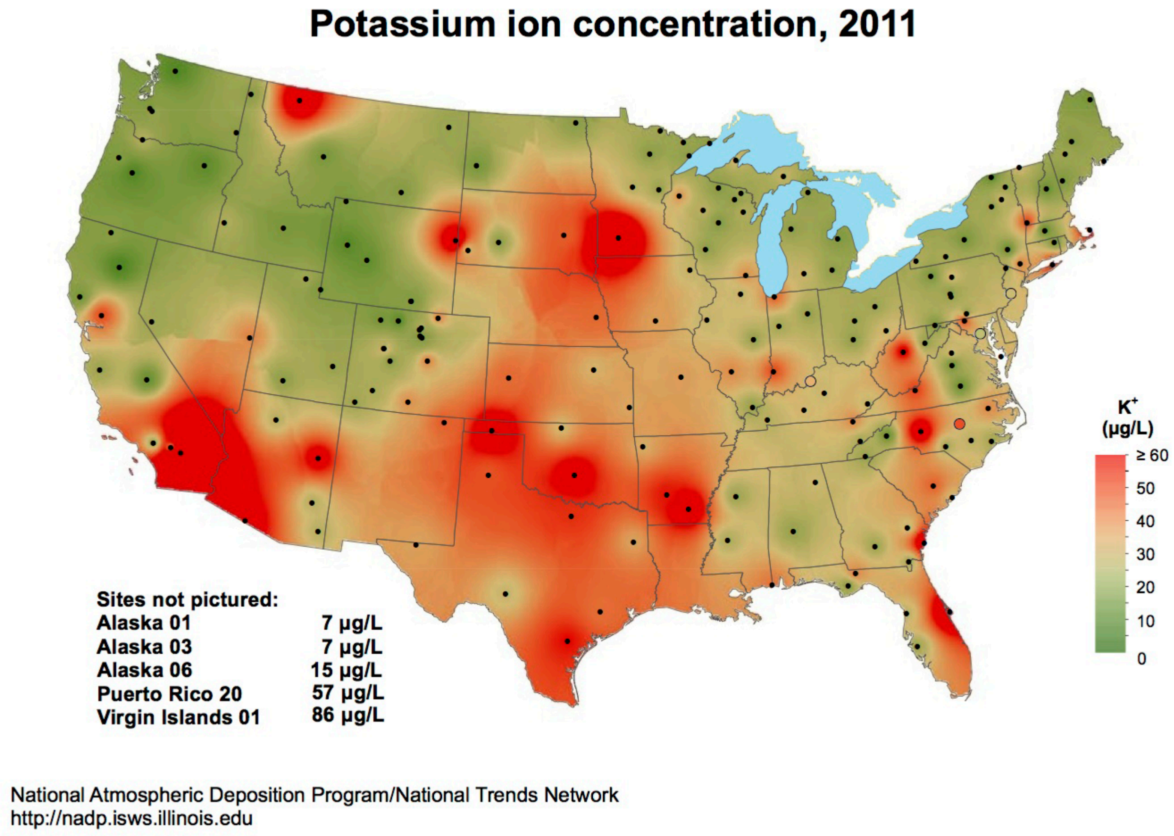


Figure 8. The amount of magnesium, potassium and calcium picked up from the air in the lab. The depicted data presents the amount of elements with any that came from the Pyrex subtracted out.

The average amounts of magnesium, potassium, and calcium of 23 beakers of water that were in open Pyrex 30-ml beakers are shown in Figure 9. A different set of beakers where also covered with parafilm following this experiment to see if the elements gained were from the Pyrex. Figure 8 presents amounts of element gained in open beakers minus that from Pyrex beaker.

Potassium does exist in the air and the annual mean estimated potassium ion deposition from the atmosphere through precipitation ranges from 0 to greater than 60 micrograms per liter of rainwater across the United States.



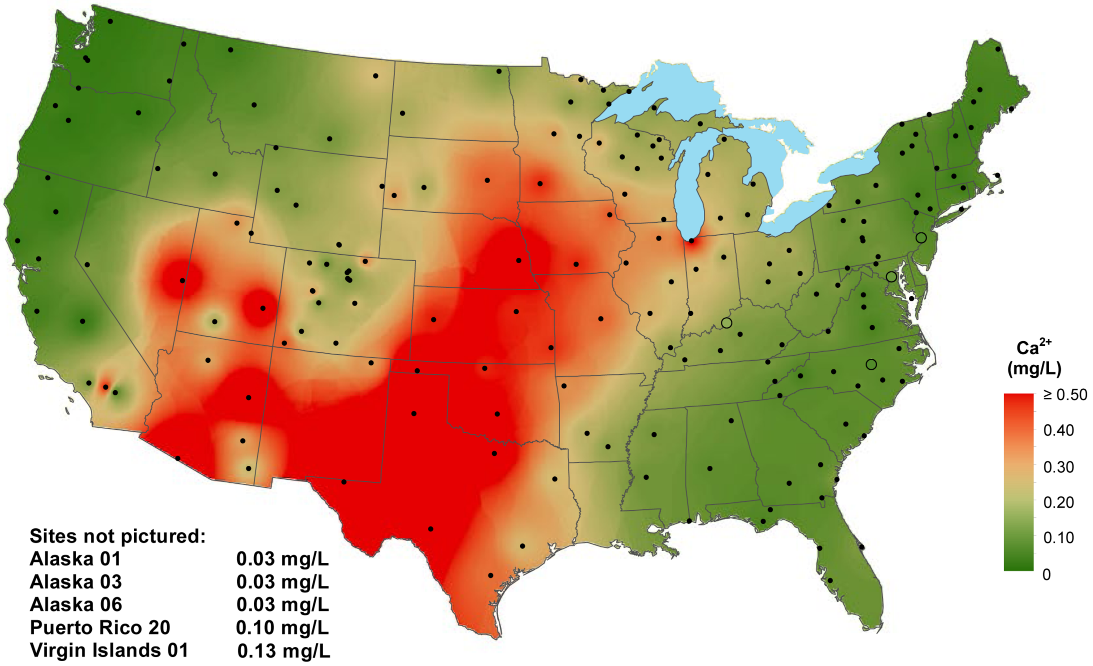
Potassium ion concentration, 2011

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

In Washington State, the average concentration of potassium ions in rainwater ranges from 0-20 µg /L. From my experiments, it appears that potassium is in the air at least in my laboratory and that the amount of potassium that is absorbed in water in an open container is consistent. With an average concentration of 13 µg potassium absorbed from air per liter of water, this falls within the levels seen in the National Atmospheric Deposition Program Trends.

Calcium and magnesium ions are also present in trace amounts in the atmosphere and it appears in varying concentrations across the United States as can be seen in the National Atmospheric Deposition Program's depiction.

Calcium ion concentration, 2011

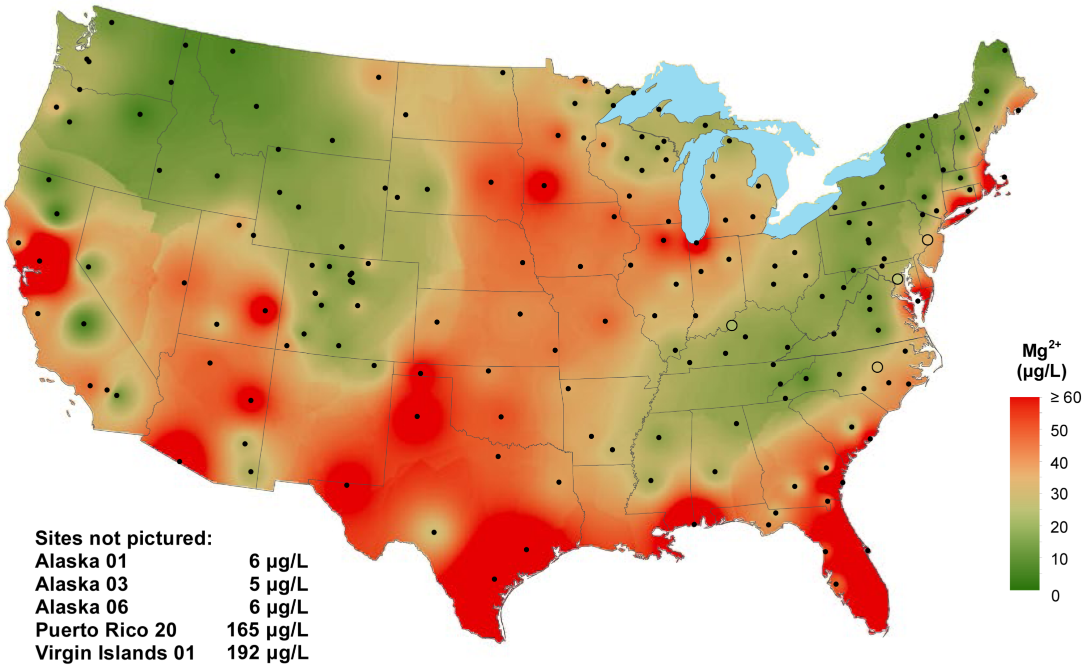


Sites not pictured:

Alaska 01	**0.03 mg/L**
Alaska 03	**0.03 mg/L**
Alaska 06	**0.03 mg/L**
Puerto Rico 20	**0.10 mg/L**
Virgin Islands 01	**0.13 mg/L**

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

Magnesium ion concentration, 2011



Sites not pictured:

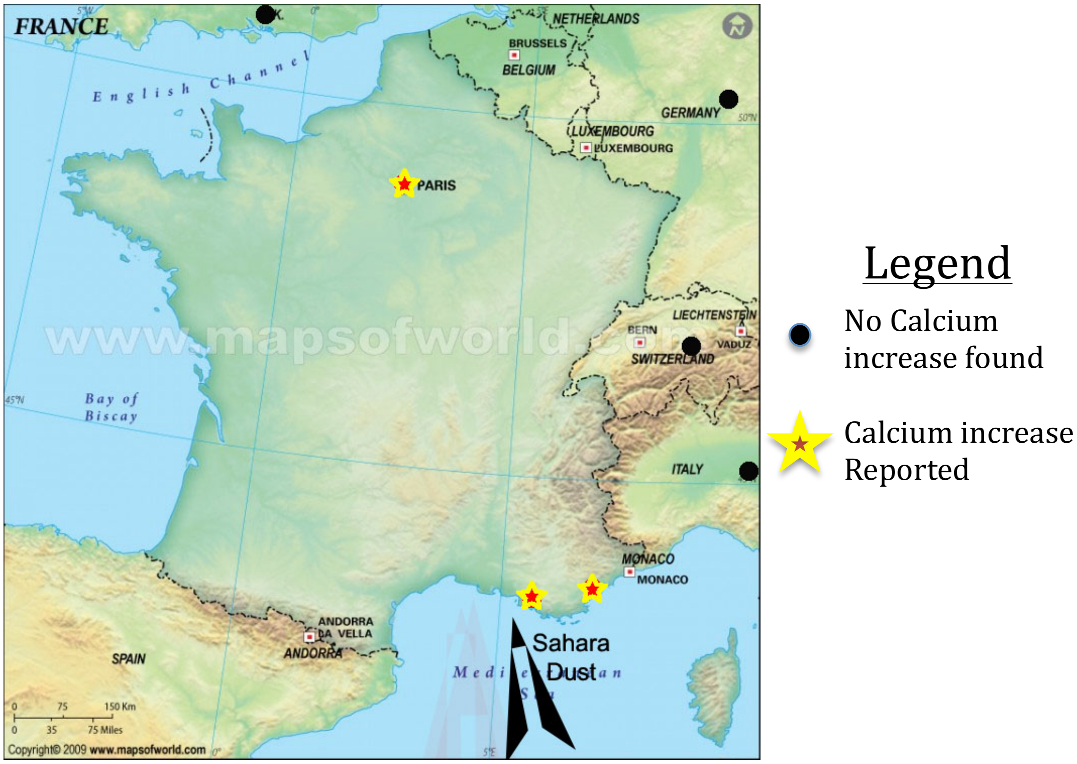
Alaska 01	**6 µg/L**
Alaska 03	**5 µg/L**
Alaska 06	**6 µg/L**
Puerto Rico 20	**165 µg/L**
Virgin Islands 01	**192 µg/L**

National Atmospheric Deposition Program/National Trends Network
http://nadp.isws.illinois.edu

The rainwater concentration of calcium ions is near zero, but magnesium appears to exist near 30 µg/L in the greater Seattle, WA area. This trend of magnesium existing in the highest concentrations followed by potassium and then calcium does not follow the results of my tests which shows potassium having the highest concentration absorbed followed by magnesium then calcium, but the test is fundamentally different in that this study seeks to determine the concentrations of these elements that will absorb from the air into standing water, versus concentrations of these elements were measured in rainwater in the National Atmospheric Deposition Program. The purpose of showing this data is to corroborate that these elements do exist in the atmosphere and it also presents a possibility for explaining why researchers in different areas could come to different results in the change in elemental composition. With wide ranges for each of these elements existing in their ionic state across the country, a researcher in Washington State may have less change in elemental composition of the sprouts versus a researcher in Texas, where high concentrations of magnesium, potassium and calcium exist in the air. Calcium in particular seems to exist in a much higher potential concentration than magnesium and potassium since the scale for its measure is in ppm instead of ppb as seen with magnesium and potassium. Regardless, the absorption of potassium in water from the air should be accounted for when looking for elemental composition changes, whereas magnesium and calcium should be noted, but the changes from airborne sources are not significant in the laboratory space where these experiments are undertaken. This also brings up the possibility that in areas where there is a higher calcium concentration in the air, one could expect higher concentrations in calcium in plants grown in that atmosphere. Kervran mentioned the possibility of calcium in air near Zundell in France in the oat experiments.

Locations of Successful Calcium Transmutation Studies Compared with Unsuccessful Studies

In reviewing the levels of calcium in the air in France, there appears to be a large influx of calcium in the form of Calcite from sand that is blown into the south of France from the Sahara Desert. According to Lequy et al. (2013) in a single 6 hour gust, up to 4.5 mg Ca/m^2 can spread across all of France. France began an ionic deposition program in the 1980's after the death of Zundel and just before the death of Kervan. Indeed when reviewing the location of researchers that have successfully shown an increase in calcium with oat species, four of the four published studies occur in France. Those are the laboratory of the French Society of Agriculture (Paris 1971), Kervran (Paris 1960-1980), Zundel (between Gasse and Canes 1979) and Jean-Paul Biberian (Marseille 2012). In comparison, researchers who tried to reproduce the increase in calcium in oat sprouts outside of France did not see an increase in calcium. Those where D.B. Long (Harpenden, UK 1971), Horber (Zurich 1976), J.A. Jungerman and Murphy (UC Davis 1977), Bernd Franke (Germany 1978) and finally Enrico Di Vito, Carla Candian, Luigi Garlaschelli and Antonio Triassi (Italy 2002). The map below geographically depicts the studies that showed an increase in calcium with the stars. The black circles represent where researchers did not see an increase in calcium. The map also depicts the direction of the incoming calcite from the Sahara Desert.



Magnesium, Potassium, and Calcium Absorbed from Pyrex and Plastic

The seeds are sprouted in polypropylene petri dishes and both the eggs and the sprouts are dissolved in nitric acid in Pyrex beakers. The samples are stored in polypropylene falcon tubes. Does the plastic or Pyrex release magnesium, potassium, or calcium to the samples that are being prepared for analysis?

Hypothesis: magnesium, potassium, or calcium are leaching into the sample solutions from the Pyrex beakers, the polystyrene petri dishes, and polypropylene falcon tubes and causing the change in elemental composition.

Experiment Design: Fill 23 Pyrex beakers with Nanopure water and cover with parafilm to seal. Fill 23 polystyrene petri dishes with Nanopure water and cover with parafilm. Fill 23 polypropylene falcon tubes with Nanopure water and cap tube. Leave water in the container types for one month and check the elemental composition to see if these elements leached from the Pyrex or plastics into the water.

Results/Discussion

It is important to assess the leaching of magnesium, potassium, and calcium from the containers that are used for the sprouting and dissolving of the sprouts or eggs to prepare them for elemental analysis. Out of the three materials, Pyrex seems to have the highest level of leaching with calcium having the highest amount leached into the water (Fig. 9). The polystyrene petri dishes do not leach magnesium, potassium, or calcium (Fig. 10). The polypropylene from the falcon tubes leaches a trace amount of calcium (Fig. 11).

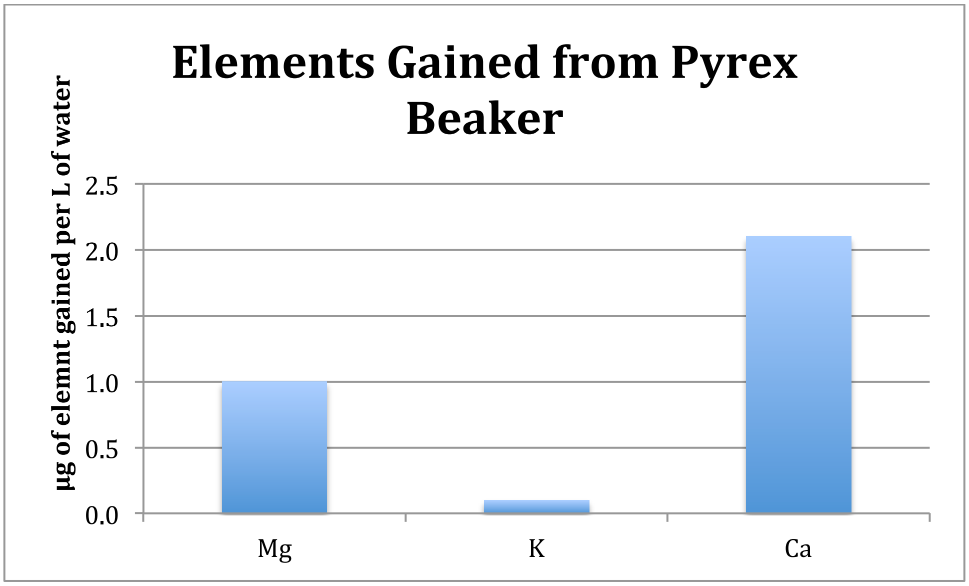


Figure 9. Magnesium, potassium, or calcium gained from sitting in a 30 ml Pyrex beaker that is covered with parafilm for one month.

When comparing this to the literature, there is little information directly about ion movement from glass to water, but Brennand (2002) has shown that magnesium, potassium, and calcium ions migrate from the surface of Pyrex glass and can undergo ion exchange, but these elements are not mobile within the glass as is sodium. Doremus (1964) has shown that the composition of Pyrex consists of 4.6% CaO, 3.6% MgO and 0.7% K_2O which nicely fits with the data in Figure 9, showing calcium has the highest diffusion into the water followed by magnesium then a slight amount of potassium.

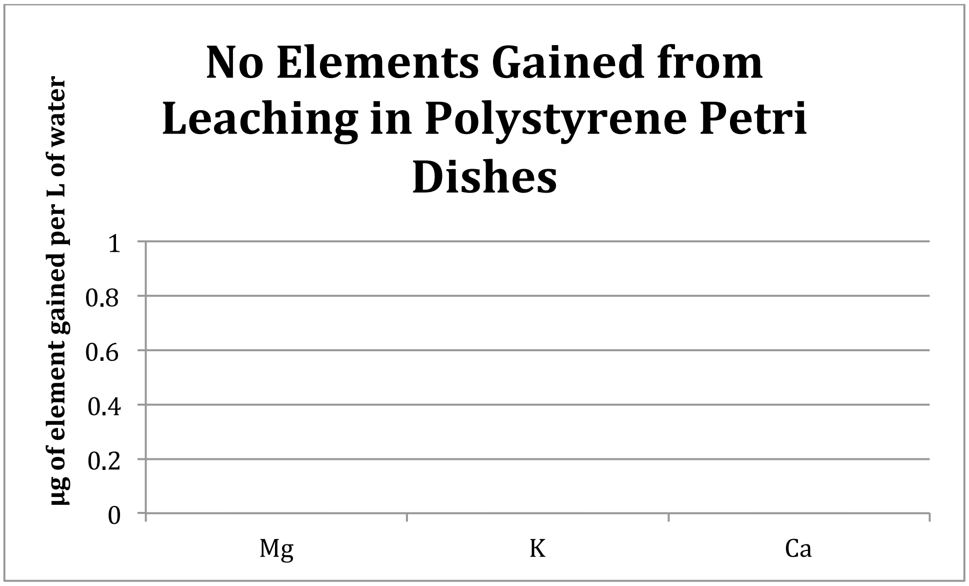


Figure 10. Elements below detection limit are assumed to not leach from the polystyrene petri dishes into water.

It is not surprising that polystyrene does not leach metals into the water considering the composition contains no Mg, K or Ca. It's formula is $(C_8H_8)_n$ (Okada, 1995). Still it can never be said that no elements are present, only that the elements exist below the detection limits of the instrument

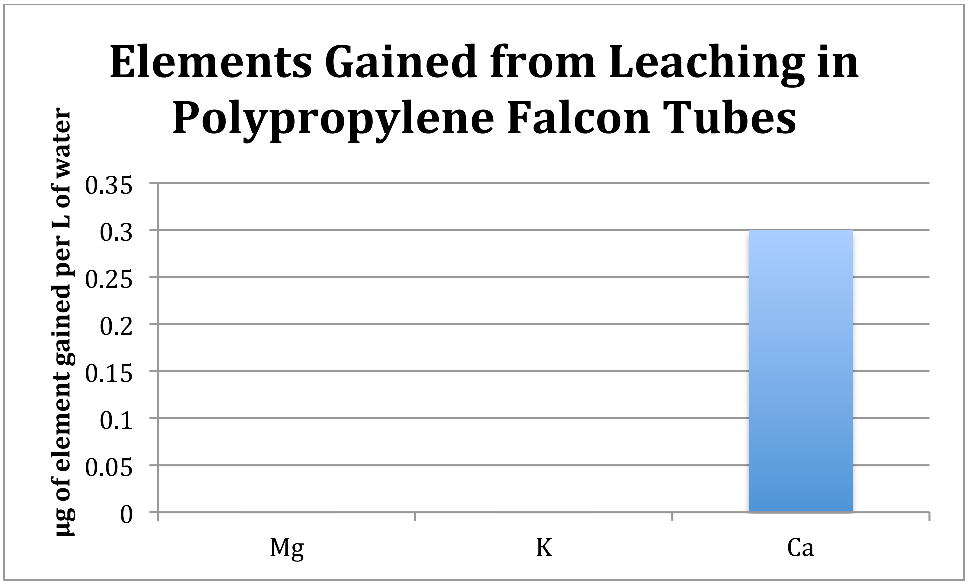


Figure 11. Very limited amount of calcium is leached into the water from polypropylene falcon tubes. No magnesium or potassium leaching was detected.

Polypropylene at first glance and a basic search also seems to contain no metals and consists only of a hydrocarbon composition of $(C_3H_6)_n$, but on review of the patent, the composition consists of a crystalline polypropylene and a precipitate of calcium carbonate (Hara et al, 1983).

Even though it is good to know that calcium is being gained from these materials, the amount is so small that it is not significant enough to account for any large gains of calcium shown in the experiments by Kervran (1983) or Zundel (1980). Indeed, when reviewing how Pyrex is used in the experiments, any elements that may be gained are negated for two reasons. First, the Pyrex is used to dissolve the plant or egg material in acid on a hot plate. At the same time a control with no plant or egg is used where just acid is added and any metals provided by the Pyrex are subtracted via the control. Second, the other area where Pyrex is used in the experiment is the volumetric flasks, but the seeds, the sprouts, and the eggs are all diluted out equally in the Pyrex including the control, so any additional elements added would be added to all samples and the control therefore it would not affect the mass balance of the experiment.

Do magnesium, potassium and calcium Evaporate with Water?

Why did the concentrations of magnesium, potassium, and calcium decrease during the sprouting of the seeds? One possibility is that these elements are transmuting, but a simpler possibility is that they may be evaporating with the water.

Hypothesis - Elements are volatilizing in air with evaporating water

Experimental Test: Add a known concentration of magnesium, potassium, and calcium with a similar concentration found in the seeds of sprouts to Nanopure water and fill 17 beakers full of the solution. Let the water sit open for one month which is the time period used to grow the sprouts then analyze the remaining water to see if any of the K, Mg or Ca volatilized with the water.

Results/Discussion:

Potassium concentrations should be increasing in sprouts since there is a small constant increase from potassium absorbing in water from the air, but in each of the sprouting experiments performed, t potassium consistently decreased. In some cases, both calcium and magnesium also decreased. Could this be caused by those elements being transported with the evaporating water? In order to test for this, 17 petri dishes filled with a stock solution of magnesium, potassium, and calcium with a similar concentration of those elements found in seed samples was allowed to sit open for one month to see if any of the elements would leave the system with the evaporating water or by other means. After one month a little more than 73% of the water had evaporated and the amount of magnesium, potassium, and calcium remained unchanged with the exception of potassium, which had increased an expected amount based on previous experiments showing that potassium from the air is absorbed in water. From this experiment, it is assumed that magnesium, potassium, and calcium do not evaporate with water. Magnesium and calcium are found in trace amounts in rainwater along the Pacific coast with the assumption that these elements evaporated with sea water (Kennedy et al, 1979), but the concentrations of these elements is higher in sea water than the water used for growing sprouts. If these elements are not lost from evaporation, perhaps they are lost with the water used for rinsing the sprouts.

Are Magnesium, Potassium, and Calcium Lost From Sprouts Due to Transfer into the Water?

If these elements do not evaporate with water, perhaps they are lost from the sprouts while watering or soaking the seeds.

Hypothesis – magnesium, potassium, and calcium are dissolving in water and leaving system when rinsing sprouts.

Experimental Design - Soak seeds with Nanopure water for 24 hours then collect the water and analyze it for elemental spectrum. After the initial soak, continue to save all the water that is used to rinse the seeds and sprouts till they are ready for analysis. Analyze each of the water samples and check to see what elements are leaching away from the seeds and sprouts into the water. Compare the loss of elements between the stages of seed and mature sprout and compare it to the elements lost in the water.

Results/Discussion

The only element that was present in the water used to soak and rinse the clover seeds and sprouts was potassium. When the amount of potassium found in the water was compared to the difference of the potassium in the sprouts compared to the initial amount in the seeds, the loss of potassium was accounted for in the sprouts as can be seen in figure 12.

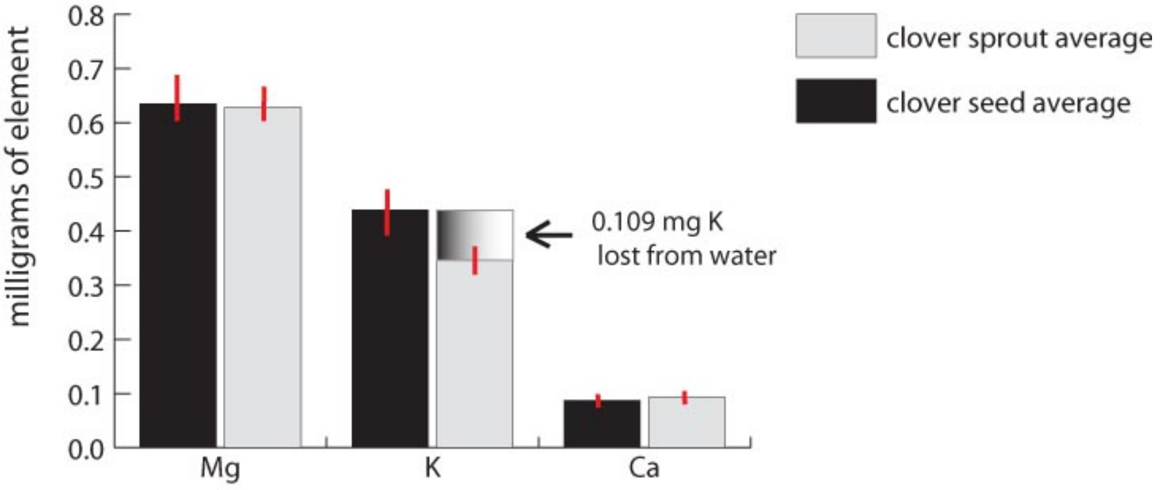


Figure 12. Potassium lost to water used to rinse sprouts accounts for the potassium difference in the seeds compared to the sprouts.

One would expect that both calcium and magnesium would be present as well since the rules of osmosis should describe the behavior of ions in solution when separated by a semi-permeable membrane, such as the interface of root cells. The concentration of elements on either side of the membrane determines the net flow of elements through the membrane. Since the Nanopure water has fewer elements than the seeds or sprout root cells, the assumption would actually be that elements would be leaving the seeds and sprouts and going into the water. The flow of water in the transpiration system may negate this though. Perhaps root cells are able to maintain a high osmotic potential but a low concentration of ions near the roots thereby continually attracting more elements than osmosis and diffusion alone should allow. As it is, basic hydraulic properties of roots are not yet adequately understood, simply because roots in the soil are much less experimentally accessible than shoots. Some ions, such as Ca^{2+} are able to be transported into root cells, even against a concentration gradient (Steudle, 2000). The current theory assumes this is done by active transport, but another possibility could be the energy contained in ordering of water along the hydrophilic interphase of the root cells and the water.

In summary, only potassium leaves the system through the water at a noticeable value.

Is the Nanopure Water Completely devoid of Calcium, Magnesium and Potassium?

Although water that measures 18.2 MW-cm is theoretically pure, in reality it may still contain parts per trillion levels of various ionic species and therefore needs to be validated.

Hypothesis – Trace contaminants of magnesium, potassium, and calcium are entering the system from the Nanopure water.

Experimental Design – Fill 23 falcon tubes with 18.2 MW-cm water and immediately run samples through the ICP system. Use a guaranteed nitric acid blank instead of a Nanopure water blank in order to insure the correct measurement of any elements in the water.

Results/Discussion

Although it is impossible to say that there are none of the elements of interest present in the Nanopure water, it is clear that if they are present they are below the limits of detection. These results are corroborated by the elemental analysis provided by Thermo Scientific Barnstead.

Element	RESULT (PPB)
Potassium	<0.1
Magnesium	<0.002
Calcium	<0.2

Table 7. Results of utilizing ICP-AES. Values are below detection limits.

Cation	RESULT (PPB)
Potassium (K^+)	<0.02
Magnesium (Mg^{2+})	<0.02
Calcium (Ca^{2+})	<0.02

Table 8. Data provided by Thermo Scientific Barnstead (2008) utilizing ion chromatography. The less than sign means the values are lower than the limits of detection with the instrumentation.

Element	RESULT (PPB)
Potassium	<0.1
Magnesium	<0.002
Calcium	<0.2

Table 9. Data provided by Thermo Scientific Barnstead (2008) utilizing ICP-MS. The less than sign means the values are lower than the limits of detection with the instrumentation.

Microorganisms Adding Elements to the System

Rather than trying to eliminate any form of microorganism from the sprouting process of the seeds or the development of the incubating eggs, another approach is to simply assume they are present and try to calculate the maximum effect they can have on the elemental composition.   This approach should lead to a more accurate assessment for three reasons:

1. A wide range of chemicals has been tested for killing microbes on sprout seeds and no single treatment has demonstrated to reduce populations of microbes by more than three logs without inhibiting germination (Taormina et al, 1999)
2. Microorganisms from the air may infect the seeds or eggs later in the experiment anyway.
3. If there is a microorganism culture and it is killed with an antimicrobial solution, it could still add elements to the system.

These difficulties arise because sprouts, incubating eggs, and bacteria are nurtured by precisely the same combination of heat and moisture (Anderson, 2011). The main microbes found on seeds, sprouts, and eggs are Salmonella and E. coli strains. Multiple studies have shown that sprouts may contain up to 10^9 colony-forming units (cfu)/g of seed or sprout without being visible (Taormina et al, 1999).

Assuming a maximum amount of 10^9 cfu/g sample, a calculation of elements potentially donated from microorganisms can be obtained. Watson et al (2013) has shown that the elemental concentration between various bacteria cells is similar. Clover sprouts have been shown to host E. coli. E. coli contain 1% of their total wet mass as inorganic ions, this includes phosphorus, sulfur, potassium, sodium, calcium, magnesium, iron, and others (Watson et al, 2013). Water is 70% of an E. coli cell, but when the water is removed and the elemental composition is measured from a dry sample, potassium makes up 1% of the dry weight, and calcium and magnesium each make up 0.5% of the dry weight (Stanier et al, 1986). The average weight of an E. coli cell is 1 x 10^{-12} g/cell wet weight. The amount of E. coli cells in a cfu range from one to a chain of around 5 (Watson et al 2013). Assuming that all the cfu are chains of 5 bacteria each, cfu will weigh 5x10^{-12} g wet weight. That means that a 10^9 cfu culture on a gram of sample will donate the following mass of magnesium, potassium, and calcium to a sprouting system:

Colony forming unitis (cfu)/g seed	Seed Weight (g)	weight of e.coli cell (mg)	number of cells per cfu	total mass of E.coli added to sprout system (mg)	Water % of Cell allocation	Total dry weight (mg)	% K of dry weight	**Potassium added to system (mg)**
1.00E+09	1	1.0E-09	5	5	70%	1.5	1%	**0.015**
Cfu	Seed Weight (g)	weight of e.coli cell (mg)	number of cells per cfu	total mass of E.coli added to sprout system (mg)	Water % of Cell allocation	Total dry weight (mg)	% Mg of dry weight	**Magnesium added to system (mg)**
1.00E+09	1	1.0E-09	5	5	70%	1.5	0.5%	**0.008**
Cfu	Seed Weight (g)	weight of e.coli cell (mg)	number of cells per cfu	total mass of E.coli added to sprout system (mg)	Water % of Cell allocation	Total dry weight (mg)	% Ca of dry weight	**Calcium added to system (mg)**
1.00E+09	1	1.0E-09	5	5	70%	1.5	0.5%	**0.008**

Table 10. Elements added from E. coli to sprout system at a level invisible to unmagnified eye.

In conclusion, it should be assumed that calcium, magnesium and potassium are added to sprouts by the presence of bacteria.

Instrument Error and Limits of Detection

Both ICP-AES and ICP-MS systems are plasma-based instrumental techniques that are used to measure metals in the ppb range. In both systems, inductively coupled plasma (ICP) dissolves, vaporizes, and atomizes aerosol samples and ionizes the resulting atoms. The methodology for preparation of samples is the same for both instruments. This has the advantage of less potential for human error in the preparation process since one processed batch of sprouts or eggs can be analyzed on both pieces of equipment. Even though both these systems use the same preparation and ICP to ionize the atoms, the method of detection is different. This has resulted in ICP-AES and ICP-MS commonly being used in tandem to check for instrument error in data collection (Tyler, 1994*)*.

On average, the difference in sample readings between these two systems is based on the limits of detection rather than each instrument showing vastly different results.

Total Elements Added or Subtracted from Sprouting System

With the assumptions set that one gram of seed is used per sample and that one liter of water is used over the duration of one month on each sample set the following change of elements is expected from the seed to the sprout from outside sources.

System adding elements	Magnesium (mg)	Potassium (mg)	Calcium (mg)
Nuclear Decay*	0	(7.4E-10)	6.8E-10
Absorbed from air	1.0E-03	1.3E-02	1.0E-03
Pyrex beakers	1.0E-03	1.0E-05	2.1E-03
Polystyrene dishes	0	0	0
Polypropylene Falcon tubes	0	0	3.0E-04
Evaporation	0	0	0
Diffusion from seed to water	0	(1.1E-01)	0
Nanopure water	2.0E-05	2.0E-05	2.0E-05
Microorganisms	8.0E-03	1.5E-02	8.0E-03
Total mg elements added or subtracted from system per gram of sample	1.0E-02	(8.1E-02)	1.1E-02

* natural nuclear decay is calculated for a human not a sprout, but the amount is so low even in a human that it does not influence the mass balance.

Table 11. Summary of expected change in magnesium, potassium, and calcium due to nature's influence.

Conclusion

From these experiments and research, a calculated change in elemental composition for magnesium, potassium, and calcium over the duration of each experiment from sources outside the system has been found. These changes in elemental composition are not large enough to account for what Kervran and Zundel have determined as biological transmutation. It has also brought up the possibility that outside sources could influence the results depending on location. Concentrations of calcium in the air for example vary depending on geological location by as much as ten orders of magnitude, which could account for variability in results between researchers in different locations. Also, *E. coli* and *Salmonella spp.* have been shown to often be present in seed sprouts and eggs and are impossible to eliminate with any chemical methods that do not inhibit germination and growth. At the same time, Vysotskii and Kornilova (2010) has shown that bacteria like *E. coli* and *Salmonella* are capable of biological transmutation. This leads to the possibility that bacteria are facilitating transmutation in a potential symbiosis with plants and animals.

After delving in to the mystery of biological transmutation, whether it exists or not is still a mystery, but from the data it does not appear to occur in the sprouting of oats, red clover, mung beans, broccoli, or in the development of chicken eggs as researchers in the past showed. In the future, this research should be continued particularly when the means for analyzing elemental concentrations arise that do not require the destruction of the seed. This would greatly reduce the problem of natural variation between different seeds and allow for more reliable comparison data. Beyond this problem, if someone wants to devise an experiment to test if biological transmutation occurs, the following recommendations should be considered.

1. The element that is studied in the experiment should not be present before the experiment starts. This greatly reduces standard deviation as a problem if the element is not present at the beginning in the seed or other culture, but appears at the end of the experiment.

2. The element being synthesized should accumulate in the experiment and not be present in the surrounding environment. This reduces the potential of diffusion of the element from the outside environment into the water or cells of the organism under examination. Regardless of how ingenious the controls devised by the researcher, some elements may slip in.

3. A new method of detection needs to be developed that can test elemental composition without destroying the sample so that the same sample can be analyzed at the start of the experiment and at the end.

When these three requirements are not met, than it is difficult to prove that there is actually biological transmutation. This is because of the possibility of contamination from outside the experiment or because of natural variation in the content of the studied elements in the plant or organism.

In past published studies on biological transmutation, none of them fulfilled all three of these requirements.

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