Failed Replication of the "Kervran Effect" (Biological Transmutation of Elements in Living Systems)

ENRICO DI VITO and CARLA CANDIAN
Istituto Tecnico Agrario Statale "G. Cantoni"
Vle Merisio 17/a - 24047 Treviglio (BG), Italy

LUIGI GARLASCHELLI
Dip. Chimica Organica
Universita' di Pavia
Via Taramelli 10 - 27100 Pavia, Italy

ANTONIO TRIASSI
DASIT spa
Via Merendi 22 - 20010 Cornaredo, Milano, Italy

Abstract - The "Kervran effect", i. e. the alleged transmutation of chemical elements within living systems, has been re-investigated by growing oat seeds in a controlled environment and measuring the total amount of Potassium, Calcium and Magnesium before and after their germination. No significant differences have been found for these elements.

Keywords: Kervran - oat seeds - biological transmutation - cold fusion

Introduction

The "Kervran Effect" is named after its proponent, the French chemist C. Louis Kervran, who claimed to have discovered it on the basis of his own, years-long, observations and analyses. It consists of the alleged transmutation of chemical elements within a living (but also inorganic) system. The nuclei of some elements would simply combine with those of others, giving rise to a third element.

For example:

$$^{39}K + {}^{1}H \text{ -----> } {}^{40}Ca$$

$$^{16}O + {}^{16}O \text{ -----> } {}^{32}S$$

$$^{23}Na + {}^{16}O \text{ -----> } {}^{39}K$$

These processes, some of which can be thought to be possible only in high-energy nuclear reactors, would spontaneously occur in living systems without any production or absorption

of detectable amounts of energy.
If true, these transmutations would contradict not only the basic assumptions of chemistry since Lavoisier, namely the laws of mass conservation, but also those of nuclear physics.
In fact, chemical reactions cannot create or destroy atoms; rather, they can only rearrange existing atoms into new molecules, depending on how their outermost electrons interact.
However, Kervran is describing nuclear reactions, like fusion or fission. We expect that both these reactions would release huge amounts of energy; furthermore, fusion processes would require a start-up temperature of millions of degrees.
Since no such energy-related phenomena have yet been observed in living systems, the alleged Kervran effect has understandably attracted even recently the attention of a small number of scientists interested in the so-called cold fusion phenomena.(Komaki, 1967, 1975, 1992, 1993)

Clearly, some of the fundamental tenets of classic physics and chemistry are here in question. No law is granted once and forever; but it is obvious that a revision of such fundamental laws calls for a faultless documentation and for very careful controls.
Experimental errors and biases in the analytical procedures, "experimenter effect", wishful thinking, hoaxes and frauds are the simplest explanations that come to mind and that must be ruled out before Kervran's claims can be considered to be real.
For all these reasons, a re-investigation and a careful independent replication of the Kervran experiments seemed necessary.

Kervran himself published only two papers on scientific journals (Kervran 1968, 1969). They consisted of experiments either on just two lobsters, or on mice. These were considered to be difficult to reproduce and to improve (using a much greater number of organisms).
He also described experiments on other systems in two of his books, (Kervran 1966, 1973) but the experimental details and the analytical procedures reported are very poorly documented.
One experiment, on the germination of oat seeds, however, was carefully repeated several times and described in sufficient details by Zündel (1980), and declared by Kervran himself in his last book (Kervran, 1982) to be the best example of a possible test of the effect. We notice that even in this paper the exact analytical procedure was not reported.
We decided therefore to follow as closely as possible Zündel's procedure and conditions, trying to improve its precision, the controls and the final analysis whenever possible.
In this replication we did not bother to apply stringent security protocols, such as double-blind procedures, coding of the samples, etc. It should be clear, however, that extraordinary claims call for extraordinary evidence; if an anomaly would have indeed been detected, we were prepared to repeat all the procedure applying tighter controls to reduce the risk of, say, experimenter effect, hoaxes, sample contamination or tampering with data by people external to the experiment, etc.

Experimental Procedures

Oat seeds

A lot of oat seeds (cultivar NAVE) were obtained from INRA (Istituto Nazionale Ricerche Agronomiche). Their expected and certified germinating power was at least 95%.
1800 seeds (total weight g 40.4709) were used for the germination process; other 1800 (total weight g 40.4926) served as the control.

Germinating device

A germinating chamber (Phytotron) was used, whose inner measures were cm 105 x 85 x 63. Inside the Phytotron we put a second chamber of cm 70 x 60 x 51 manufactured with Plexiglas (perspex, poly-methylmethachrylate).
Inside this tank we put two 54 x 45 cm perspex panels to accommodate for 36 Petri dishes where the seeds were to be grown. This chamber was air-tight and was provided with an additional 20 W UV lamp.
The Phytotron provided for the thermal regulation. The temperature was set at 28 °C and was constantly checked by means of an inside probe and an external display. However, in the first four days of the experiment the heat from the external lamp raised the inside temperature to 41 °C. We moved the lamp a bit away (cm 70), so that during the light period (see below) the maximum T was 35 °C, and during the dark period the T was the room temperature of 20-21 °C.
Thirty-six round polythene Petri dishes (diam. mm 90) were located on each perspex panel, under the watering tubes. In every dish we put a round Whatman ashless filter paper and 50 evenly distributed oat seeds.

Air treatment

The air supply was provided by an external unit comprising: a small membrane pump; a filtration device containing a 0.45 ultramembrane; a bubbler containing N/10 HCl followed by a second one with sat aq $NaHCO_3$, and an empty safety bottle.

At the exit from the Phytotron, the air was led through a second empty safety bottle, a manometer gauge (that could be regulated to obtain a small positive pressure inside the chamber) and finally a last bubbler filled with water.
A small fan inside the chamber assured the circulation of the air.

Water treatment

The water used was deionized and bi-distilled, and had a pH = 5.8 - 6. It was stored in a closed polythene reservoir, and delivered automatically to the sprouts through a small peristaltic pump and a plastic tubing running over the sprouts and having a number of tiny holes from which the water could drip.
The amount of water consumed after the 28 days was *ca* 5500 ml. Not all of this water, however, dripped into the Petri dishes since as the sprouts grew longer they prevented some of the water from doing so; dripping from the tubing itself was also somewhat uneven. At the end of the germination period, *ca* 1500 ml of water were collected from the bottom of the Phytotron. In any case, 4000 ml of the same water used for the experiment were evaporated, and analysed for their Calcium contents, using the same techniques as for the plant analysis. This amount was considered to be negligible with respect to the total Calcium of all the 1800 seeds (see below for analytical data).

Light condition

The light condition for the germinating tank was provided by an external lamp (Osram Power Star 400 W) at a distance of 70 cm (see above), for 12 h of light period followed by 12 h of dark period.
A 20 W UV lamp was put inside the tank, below the middle panel, and also switched on during the light period.

General remarks

As reported, owing to unhomogeneity of some conditions, the seedlings' growth was also uneven. Difference in the temperature caused some of the seeds to germinate later; a few dishes developed traces of moulds toward the end of the experiment.

Sample preparation

At the end of a growing period of 21 days two samples were prepared by one of the Author (EDV).
Sample A contained all the oat sprouts as they were after the 21 days (including roots, ungerminated seeds, small amount of moulds, etc.), 36 ashless filter paper discs and the water that was in the Petri dishes at the moment of the crop.
Sample B contained 1800 seeds, 36 ashless filter paper discs, and 4000 ml of the same water used for the growth.
A third sample (C) was prepared reducing to dryness 4000 ml of water.
The reagents used were from BDH, Spectrosol line. The water was deionized and bidistilled.

One former criticism to Zündel's results (see in Komaki, 1969, p.257) was that Calcium in the sprouts is present mainly as the pectate, which is transformed in the oxide by dry ashing at 850°C; while before the germination Calcium is partly in the form of its sulphate or phosphate, which are not decomposed at 850°C and not dissolved during the following treatment with HCl. This might explain the increased contents of Ca found after germination. We decided therefore to dry-ash the plants at 950 °C, temperature which should obviate for these inconveniences.

A large quartz crucible (capacity 900 ml, 105 x 165 mm diam) was used because preliminary tests showed that at 950 °C inox steel containers were attacked and corroded. Porcelain was excluded since K and Na silicate were detected in this material. The quartz crucible that we decided to use (manufactured by Soffieria Sestese, Sesto S. Giovanni, Milan) was not corroded, but developed a few stains after treatment of the material at 950 °C. We were confident that possible Si contamination might be controlled in the analytical step ($LaCl_3$ addition, see below).
Both samples A (sprouts), B (control seeds) and C (4000 ml water) were treated in the same way.
They were dried at 110 °C for 8 h, then dry-ashed on a Bunsen flame and in the quartz crucible until complete carbonisation. The ashes were then kept for 4 h at 550 °C, then 4 h at 850 °C and 8 h at 950 °C.
The glassy ashes thus obtained were carefully dissolved in 20 ml 65% HNO_3, diluted with H_2O and heated at 60 - 70 °C for 30 min. The residue was dried, redissolved in 36% HCl, diluted with H_2O, filtered into a volumetric flask and brought up to 200 ml. Filter, crucible etc. were washed with water until neutrality.

Analysis

Aliquots were taken from samples A, B and C and were analysed in two independent laboratories: at the Istituto Tecnico Agrario Statale "G. Cantoni" in Treviglio on a Perkin Elmer Instrument, and in a professional laboratory on a Perkin Elmer Optima 3000 Optical ICP Instrument (in this laboratory the operators were ignorant as to what the samples were.)

K was analysed by Atomic Emission (766.5 nm) with addition of 0.1 % CsCl.
Ca was analysed by Atomic Absorption (422.7 nm) with addition of 1 % $LaCl_3$.
Mg was analysed by Atomic Absorption (285.2 nm) with addition of 1 % $LaCl_3$.

Results

For all the experimental measures done in this paper the values are the average of three determinations and the RSD is 3% for K and 2% for Ca and Mg.

Results 1 (I.T.A.S.)

	SAMPLE A (sprouts)	SAMPLE B (seeds)
Potassium	153,6 mg/1800 sprouts	163,6 mg/1800 seeds
Calcium	25.35 mg/1800 sprouts	25.60 mg/1800 seeds
Mg	46.4 mg/1800 sprouts	45.7 mg/1800 seeds

Sample C was analysed for Calcium, whose amount was 0.00046 mg/l, namely, if 4000 ml were used up by 1800 seeds, *ca* 0.001 mg/100 seeds (see above).

Results 2 (OPT ICP)

	SAMPLE A (sprouts)	SAMPLE B (seeds)
Potassium	150 mg/1800 sprouts	153 mg/1800 seeds
Calcium	24.4 mg/1800 sprouts	24.8 mg/1800 sprouts
Mg	46.4 mg/1800 sprouts	48.2 mg/1800 seeds

Results 3 (University of Pavia)

Calcium only was also analysed (blind procedure) at the Dept. of Analytical Chemistry, University of Pavia, both by standard addition and by calibration curve, and with a 0.1% La^{3+} addition, on an I.L. Atomic Absorption spectrophotometer, giving the following results:

	SAMPLE A (sprouts)	SAMPLE B (seeds)
Calcium	23.44 mg/1800 sprouts	26.4 mg/1800 seeds

Conclusions

The "Kervran effect" could not be replicated.
All results indicate that, well within the method's precision, there is no increase or variation in the total amounts of Calcium, Potassium and Magnesium in oat seeds after germination.
We encourage other researchers to independently repeat these experiments as accurately as possible. If results will constantly be negative, then the probability of a bias, a systematic or analytical error in Kervran's and others' results must indeed be considered.

Acknowledgements

We thank Dr Lucia Cucca (Dept Anal. Chem., University of Pavia) for analysis of Calcium, and Drs Massimo Scotti and Francesco Gatti (Dasit SpA) for the construction of the germination chamber and its control systems.

References

Kervran, C. L. (1966). *A la Découverte des Transmutations Biologiques*
Le Courrier des Livres, Paris.
(Ital. transl.: Alla Scoperta delle trasmutazioni biologiche; Edizioni Edagricole, Bologna, 1969.)

Kervran, C. L. (1968). Increase in animal Calcium and Phosphorous concentration induced by a dietary overload of Magnesium.
Rev. Pathol. Comp. Med. Exp., 5 (4), 209-12.

Kervran, C. L. (1969). Non-zero balance of Calcium, Phosphorous and Copper in the

lobster.
Rev. Pathol. Comp. Med. Exp., **6** (5), 303-10.

Kervran, C. L. (1973). *Preuves en Geologie et Physique de Transmutations a Faible Energie* Librarie Maloine S. A. Ed., Paris.

Kervran, C. L. (1982). *Transmutations Biologique et Physique Moderne* Maloine S. A. Ed., Paris.

Komaki, H. (1967). Production de Proteins par 29 souches de microorganismes et augmentation de potassium en milieu de culture sodique, sans potassium.
Revue de Patologie Comparée **67**, 213-216.

Komaki, H. (1969) Formation de proteines et variations minerales par des microorganismes en milieu de culture, sort avec ou sans potassium, sort avec ou sans phosphore.
Revue de Patologie Comparée **68**, 83-88.

Komaki, H et al. (1992). An Approach to the probable mechanism of the Non-radioactive Biological Cold Fusion or so-called Kervran Effect
Abstract of the 4th International conference on Biophysics and Synchrotron Radiation (BSR 92), p 272, Tsukuba, August 30th-September 5th

Komaki, H (1993). Observations on the Biological Cold Fusion or the Biological Transmutation of Elements
Frontiers of Cold Fusion, Universal Academy Press.

Komaki, H. and Kervran, C. L. (1975). *Experiences de Komaki (I, II et III serie) Preuves en biologie de transmutations à faible energie;*
Maloine, S. A. - Paris, 116-130.

Zündel J. E. (1980). Etude sur la variation du calcium dans les graines d'avoine pendant leur germination en eau bidistillee.
Riv. Biol., **73** (2), 238-245