Ciência e Tecnologia

Para o Desenvolvimento Ambiental, Cultural e Socioeconômico

Xosé Somoza Medina
(organizador)

EDITORA ARTEMIS
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VOL II

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PRÓLOGO

Este libro presenta una colección de artículos de investigación que bajo distintos ámbitos de conocimiento realizan avances de interés en la ciencia y la tecnología. La sociedad del siglo XXI se distingue de la de épocas pretéritas por su capacidad analítica. A diferencia de lo que ocurría en otras épocas, en nuestro mundo contemporáneo tenemos demasiada información y avanzar en el conocimiento significa realizar una investigación original sobre otros antecedentes previos y analizar una gran cantidad de datos para poder extraer conclusiones que signifiquen un desarrollo, un avance entre la situación anterior y la posterior, aunque sea a pequeña escala en un contexto local y en un ámbito científico muy concreto. La suma de miles de esos pequeños avances y la interconexión mundial sostienen a la ciencia y la tecnología del siglo XXI.

Este es el objetivo de este libro, realizar avances en la ciencia y la tecnología para el desarrollo ambiental, cultural y socioeconómico, desde un posicionamiento académico, comprometido con el rigor científico y el desarrollo del ser humano.

Para ello se han compendiado veinticuatro artículos de investigación en dos apartados, ciencia y tecnología. En el primer conjunto nos encontramos con artículos que desde las ciencias ambientales o las ciencias sociales realizan propuestas de mejora de aspectos concretos sobre hidrología, regeneración de suelo agrícola, cuidado ambiental, recursos humanos, ciudades igualitarias o paisajes culturales.

En el segundo bloque, se agrupan trabajos de ingeniería química, ingeniería industrial o ingeniería forestal que relatan avances en distintas tecnologías, relacionadas con el biogás de los vertederos de residuos, los usos de nuevos materiales sintéticos, la química de determinados productos y su toxicidad, o las características bioestructurales de la madera de roble.

Xosé Somoza Medina
Universidad de León, Espanha

SUMÁRIO

CAPÍTULO 17

PARTIAL REPLACEMENT OF SODIUM CHLORIDE BY POTASSIUM CHLORIDE IN GREEN TABLE OLIVES. LOOKING FOR A HEALTHY AND ECONOMIC ALTERNATIVE IN ARGENTINA

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Mariela Beatriz Maldonado
CONICET
Universidad Tecnológica Nacional
Facultad Regional Mendoza
Departamento de Ingeniería Química
Mendoza – Argentina
ORCID 0000-0002-4188-8005

Leonel Lisanti
Universidad Tecnológica Nacional
Facultad Regional Mendoza
Departamento de Ingeniería Química
Mendoza – Argentina
ORCID 0000-0002-8623-4953

Ariel Márquez
Universidad Tecnológica Nacional
Facultad Regional Mendoza
Departamento de Ingeniería Química
Mendoza – Argentina
ORCID 0000-0003-2330-7905

Noemi Graciela Maldonado
Universidad Tecnológica Nacional
Facultad Regional Mendoza
CeReDeTeC
Mendoza – Argentina
ORCID 0000-0001-6997-8080

Pablo Enrique Martín
Universidad Tecnológica Nacional
Facultad Regional Mendoza
CeReDeTeC
Mendoza – Argentina
ORCID 0000-0001-9264-6228

Daniela Adriana Barrera
Universidad Tecnológica Nacional
Facultad Regional Mendoza
CeReDeTeC
Mendoza – Argentina
ORCID 0000-0003-4907-4281

ABSTRACT: Seventy percent (70%) of the daily recommended amount of salt (Sodium Chloride) consumed is already included in the most common industrialized foods (bread, sausages, canned, frozen, cheese, soups and packaged food in genera l)because it is incorporated during the process of elaboration. The World Health Organization (WHO) recommends a daily intake of 5 g of salt of sodium. An excessive consumption of salt (sodium chloride) increases blood pressure and thus the risk of stroke, heart disease and nephropathy. It also causes recurrent renal lithiasis, it is a probable procarcinogen of gastric cancer, and it also participates in the pathophysiological bases of osteoporosis, obesity, cardiovascular diseases not dependent on blood pressure. According to the Ministry of Health of Argentina, it is consumed more than

twice the recommended salt. To reduce risks, one of the alternatives is to replace sodium in foods. One example is the use of potassium chloride, which achieves greater synergy when mixed in the appropriate percentage with sodium chloride, thus achieving low levels of sodium in the food. To accomplish that, sized Arauco variety olives were used, previously debitttered, fermented and washed until no sodium was present. They were placed in new brines where NaCl was replaced with 10, 20 and 30% of KCl of the total NaCl (control). Two 'affective' tests were used: measurement of the degree of satisfaction and preference test. The concentration of Na and K ions were mathematically modeled.
KEYWORDS: Potassium chloride. Olives. Functional foods. Mathematical modeling.

REEMPLAZO PARCIAL DE CLORURO DE SODIO POR CLORURO DE POTASIO EN ACEITUNAS VERDES DE MESA. EN BUSCA DE UNA ALTERNATIVA SALUDABLE Y ECONÓMICA EN ARGENTINA

RESUMEN: El setenta por ciento (70%) de la cantidad diaria recomendada de sal (cloruro de sodio) consumido ya está incluido en los alimentos industrializados más comunes (pan, embutidos, enlatados, congelados, quesos, sopas y alimentos envasados en general) porque se incorpora durante el proceso de elaboración. La Organización Mundial de la Salud (OMS) recomienda una ingesta diaria de 5 g de sal de sodio. Un consumo excesivo de sal (cloruro de sodio) aumenta la presión arterial y por lo tanto, el riesgo de accidente cerebrovascular, enfermedad cardíaca y nefropatía. El exceso de sal puede causar litiasis renal, es un probable procarcinógeno del cáncer gástrico, y participa en las bases fisiopatológicas de la osteoporosis, obesidad, enfermedades cardiovasculares, y en otras enfermedades no dependientes de la presión arterial. Según el Ministerio de Salud, en Argentina, se consume más del doble de la sal recomendada. Para reducir los riesgos, una de las alternativas es reemplazar el sodio en los alimentos. Un ejemplo es el uso de cloruro de potasio, que logra una mayor sinergia cuando se mezcla en un porcentaje con cloruro de sodio, logrando así niveles bajos de sodio en la comida. Con este objetivo se utilizaron aceitunas calibre variedad Arauco, previamente desamarizadas, fermentadas y lavadas hasta que no haya sodio presente y luego se colocaron en salmueras de potasio. Las aceitunas fueron colocadas en salmueras nuevas donde se reemplazó NaCl por 10, 20 y 30% de KCl del total de NaCl (control). Se utilizaron dos pruebas 'afectivas' para la medición del grado de satisfacción y prueba de preferencia. Por otra parte, la concentración de iones de Na y K fue modelada matemáticamente.
PALABRAS CLAVES: Cloruro de potasio. Aceitunas. Alimentos funcionales. Modelación matemática.

INTRODUCTION

Dietary salt intake plays a critical role in regulating blood pressure. There is evidence from the epidemiological studies (ICRG,1988), migration studies (Poulter et al., 1990), population-based intervention studies (Forte,1989), treatments trials, and genetic studies (Lifton, 1996) that dietary salt is a causal factor for the raised blood pressure and the current high salt intake is largely responsible for the rise in blood pressure with the age.

Raised blood pressure is the major cause of cardiovascular disease, accounting for 62% of strokes and 49% of coronary heart disease (WHO, 2002). In addition, accumulating evidence shows that a high salt intake could independently predict left ventricular hypertrophy, although this remains controversial (WHO, 2004). A policy statement from the Panel of Experts of the Pan American Health Organization (PAHO) established (2020) as the expected date for compliance with this recommendation in the Region of the Americas (Campbell,2012). For its part, in Argentina; In December 2013, Law 26,905 was promulgated and sanctioned, whose main objective is to promote the reduction of the consumption of Sodium in the population, and also to determine guidelines for the development of sanitary policies that lead to the promotion of healthy habits. This is fixed, the maximum sodium levels to be contained in certain food groups, and the adaptation periods to which manufacturers must adjust. Its known that, 70% of the recommended daily allowance of salt (Sodium Chloride) consumed is already included in the most common industrialized foods (bread, sausages, canned, frozen, cheese, broth, soups and packaged in general) because it is incorporated during the same process of elaboration. To reduce risks, one of the alternatives is to replace sodium in food. One example is the use of potassium chloride, which achieves greater synergy when mixed in the proper percentage with sodium chloride. The key is to arrive at a perfect combination for the consumer to accept. NaCl plays an important role in table olive processing affecting the flavour and microbiological stability but apparently, NaCl may be substituted of salt mixture in the fermentations (Bautista et al., 2010). In Argentina it is still not usual to ferment with these mixtures and generally an important remnant of fermented olives is kept at the end of the season. It is a custom to add more NaCl and other preservatives. Then the final destination of these olives are used in pizzas and sale to the public. Sometimes, they are not palatable because of the excess of salt. Taking into account these data, the objective of this research was based on the transformation of formulation of green table olives conservation, which are fermented with different concentrations of NaCl. To reduce sodium levels of the product were used mixtures of NaCl and KCl, and finally to achieve higher value to the final product.

2 MATERIALS AND METHODS

The treatments trials were based on transformation of fermented green olives with NaCl, Arauco variety; in olives without sodium first. They were subjected to several washes with deionized water for 24 hours: two washes of 8 hours each, the third of 6 hours and the last of 4 hours: in order to desalinate as much as possible, until the lowest sodium level (0,71 ppm of Na). The olives used for the test were of uniform size, of average size: weight: 579 mg; diameter: 193 mm; length: 210 mm.

Four triplicate trials of different concentrations of NaCl (sodium chloride) and KCl (potassium chloride) were carried out. It is important to mention that the formulations were made using water of typical Mendoza region (rich in Ca+2 and Mg+2). The first one consists of 100% NaCl, or "control treatment". The second is replaced by 10% of the total of NaCl by KCl. The thirdly is composed by 80% NaCl and 20% KCl. The last one: 70% NaCl and 30% KCl. 7-liter containers were used and 4.5 kg of olives were placed, then completed with 3 liters of brine prepared with the different formulations up to a concentration of 8.5% brine. After that, it was added: 0.3% of HCl; 3.6 g of benzoic acid and 5.4 g of sorbic acid. The trials were controlled for almost two months. It was measured the pH measured with a peach-meter (Denver model BHR-I), acidity [9] and several sampling of brine were taken to measure sodium and potassium in a flame photometer Metrolab model 315.

2.1 TEST OF SENSORIAL ANALYSIS

In agreement with Anzaldúa - Morales (1994) two types of "affective" tests were used for sensory evaluation: Preference test and Proof of acceptance. In the first test the judges were asked which of the coded samples preferred and why even if they were not sure. Each judge evaluated each sample only once. The proof of acceptance consisted in a structured 5-point hedonic scale: Dislikes me a lot (-2); I dislike (-1); I do not like it or dislike it (0); I like (1) and I really like (2) On this scale, he was allowed to assign a category to more than one sample. The tests were carried out in the tasting room of Don Bosco Faculty. The finished products were analyzed by 50 randomly selected untrained males and females judges, from 24 to 60 years old, including non-consumers, eventual consumers and consumers of this fruit. Each judge was given a sample, of each of the treatments in the corresponding containers, arranged in a horizontal line at random. Each container contained 2 olives of each treatment.

2.2 MATHEMATICAL MODELING

Based on the shape of the experimental curves measured in the laboratory, it was proposed as model of the variation of the concentration in brine C (t) in relation to the time:

$$\boldsymbol{C(t) = c(\infty) + \frac{C_0 - c(\infty)}{1 + b.t}} \quad (1)$$

c (∞) is the value of the final concentration when the fruit is saturated, or when the submerged time tends to infinite.

C0 represents the value of the initial concentration when the fruit is submerged.

In order to determine b, an intermediate value of the concentration C2 (t2) must be taken at a given time t2, and the value of b is cleared from the equation:

$$C(t) = c_2 = c(\infty) + \frac{C_0 - c(\infty)}{1 + b.t_2} \quad (2)$$

Clearing:

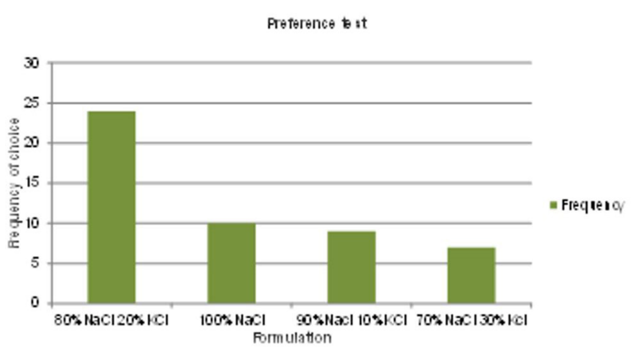
$$b = \frac{[(c\_0 - c(\infty))/(c\_2 - c(\infty))]}{t_2} - 1 \quad (3)$$

It should be clear that the value of C2 is measured for a later time t2 as the olives were submerged. For the studied, the value of the concentration was taken 16 later at the beginning of the experiment.

3 RESULTS

It can be observed in Figure 1, that the highest preference was for the formulation: 20% of KCl and 80% of NaCl. This represented a preference of 48%, followed by the Control composed by 100% of NaCl wich represented a preference of 20%. Thirdly on the formulation: 30% KCl and 70% NaCl with 16% of prefence. And finally the formulation: 10% of KCl and 90% of NaCl which represented a preference of 15%.

Figure1: Test of preference.



3.1 MATHEMATICAL MODELING

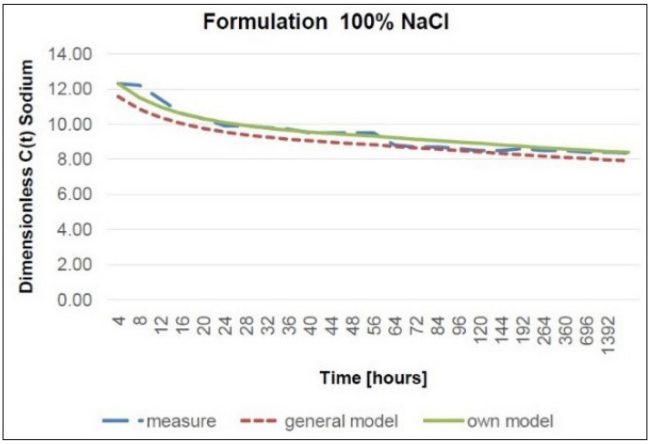
Two models were established: The own model is the model applied to each particular situation, with the own data of initial and final concentrations, and the corresponding one at 16 hours. The general model is the one that tries to integrate all the data using the boundary conditions the initial average data until the final data inclusive. The parameters used by the model were showed in the following Table.

Table1: Parameters used by the own model.

Co	C1	b	t2
1.39	0.36	0.0125	16
3.25	1.1	0.109375	16
5	1.95	0.19140625	16
average			
3.21	**1.14**	**0.10**	**16.00**

The model fitted very well for both ions that are chemically very similar in characteristics by their location in the periodic table. Their salts form electrolytic solutions in aqueous solution and have similar properties. The mathematical model allowed to predict the behavior of the concentration in the time once the solution has been saturated from the 16 hours onwards. Both ions behaved in a similar way because the skin and the flesh of olives were permeabilized by the debittering process. Simply, the difference between them was in the concentration of the formulation used. It should be noted that the sodium concentration is always higher than that of potassium as can be seen in the following Figures.

Figure 2: Model of variation of sodium concentration over time. Formulation: 100% NaCl.



It can be observed in Figures 2 and 3 that shows the control formulation: 100% NaCl that the measured sodium data fitted perfectly with both models, which does not happen so well for potassium ion. Low concentration could be occurs given in the formulation and maybe the flesh of the olive too. Potassium adjusted perfectly to the own model once it passed the 40 hours approximately. From there, both models were adjusted to the experimental data with great accurately.

Figure 3: Model of variation of Potassium concentration over time. Formulation: 100% NaCl.

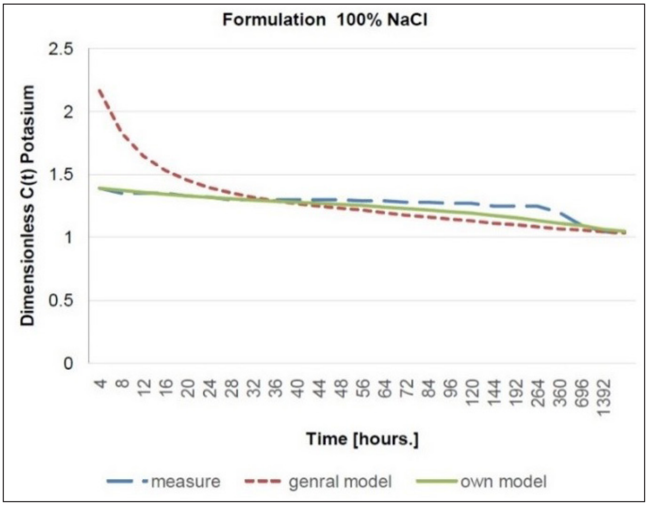


Figure 4: Model of variation of sodium concentration over time. Formulation: 80% NaCl 20%KCl.

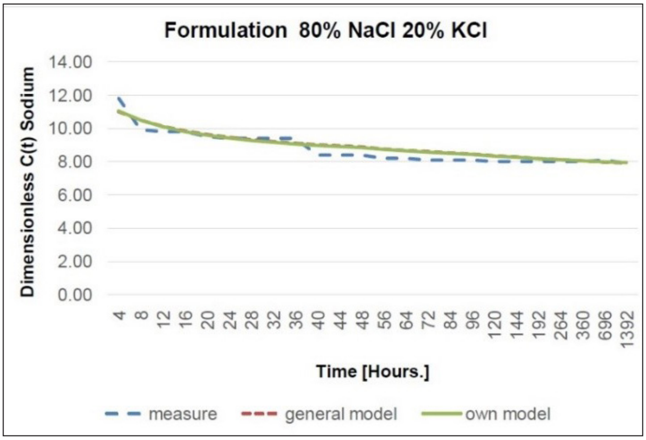
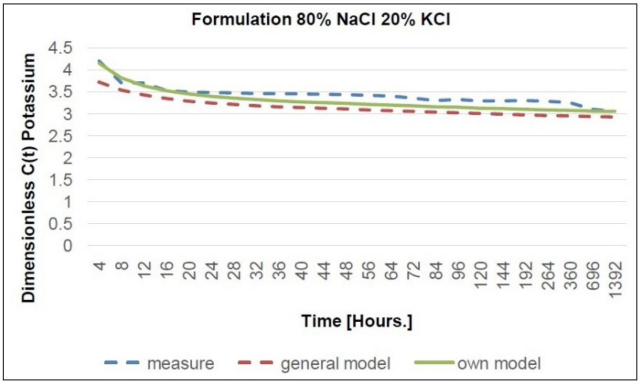


Figure 5: Model of variation of Potassium concentration over time. Formulation: 80% NaCl 20% KCl.



It can be seen from Figures 4 and 5 that as the formulation KCl concentration increased, the adjustment of the measured data behaved more closely for the both ions. This is consistent with the own model itself and the general model presented by Excel on average data. The same behavior was observed for sodium and potassium. This was verified in all formulations where the potassium content was increased (data not shown) but showed an excellent fit. This allows the own model to predict the behavior of the concentration of the ions over time, once washed solution saturated, after 16 hours. In all cases the ions concentration measured in the brine decreased in the time. Possibly this would indicate that the greater diffusion of sodium and potassium to the interior of the fruit happened during firsts hours, because the flesh and skin of the olive was already permeabilized by the debittering process.

Probably these two ions would diffuse, if we continued investigating, very similar, in spite of having a differential diffusion like almost all substances: size, affinity, other properties and type of behavior in the olives matrix. The only fact because of that varies in this trial is the concentration existing in the formulation. In the olives, the concentration of potassium is higher than sodium, but the processing of green olives incorporates more sodium by the debittering with lye and after that, when they are placed in brine, in general.

4 CONCLUSIONS

The formulation preferred by untrained consumers was 80% NaCl 20 % de ClK. It had a preference of 48%, versus the control composed by 100% of NaCl with 20% of preference.

The synergy of the two salts in the preservation of olives made the product organoleptically accepted by the panelists in the tasting.

It was also concluded that potassium chloride does not affect the conservation of olives.

It was possible to decrease the concentration of Sodium in such a way that the taster failed to notice the presence of the ions Potassium in the product.

This formulation is desirable for a healthier lifestyle; with respect to eating habits. Potassium chloride is more expensive than sodium chloride. But the risk of affecting health is even more expensive when measuring long-term consequences: costly medical treatment and risk of stroke or other pathologies. For this reason, the formulation found is more palatable and it is very important for the elaboration of a functional product.

This simple process increased the value added to the final product.

The own model fitted perfectly to the measured data, after the solution of the brine was saturated at 16 hours. This model allows predicting the behavior of ion concentration once passed the saturation.

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SOBRE O ORGANIZADOR

Xosé Somoza Medina (1969, Ourense, España) Licenciado con Grado y premio extraordinario en Geografía e Historia por la Universidad de Santiago de Compostela (1994). Doctor en Geografía e Historia por la misma universidad (2001) y premio extraordinario de doctorado por su Tesis "Desarrollo urbano en Ourense 1895-2000". Profesor Titular en la Universidad de León, donde imparte clases desde 1997. En la Universidad de León fue Director del Departamento de Geografía entre 2004 y 2008 y Director Académico de la Escuela de Turismo entre 2005 y 2008. Entre 2008 y 2009 ejerció como Director del Centro de Innovación y Servicios de la Xunta de Galicia en Ferrol. Entre 2007 y 2009 fue vocal del comité "Monitoring cities of tomorrow" de la Unión Geográfica Internacional. En 2012 fue Director General de Rehabilitación Urbana del Ayuntamiento de Ourense y ha sido vocal del Consejo Rector del Instituto Ourensano de Desarrollo Local entre 2011 y 2015. Ha participado en diversos proyectos y contratos de investigación, en algunos de ellos como investigador principal, con temática relacionada con la planificación urbana, la ordenación del territorio, las nuevas tecnologías de la información geográfica, el turismo o las cuestiones demográficas. Autor de más de 100 publicaciones relacionadas con sus líneas de investigación preferentes: urbanismo, turismo, gobernanza, desarrollo, demografía, globalización y ordenación del territorio. Sus contribuciones científicas más importantes se refieren a la geografía urbana de las ciudades medias, la crisis del medio rural y sus posibilidades de desarrollo, la evolución del turismo cultural como generador de transformaciones territoriales y más recientemente las posibilidades de reindustrialización de Europa ante una nueva etapa posglobalización. Ha participado como docente en masters y cursos de especialización universitaria en Brasil, Bolivia, Colombia, Paraguay y Venezuela y como docente invitado en la convocatoria Erasmus en universidades de Bulgaria (Sofia), Rumanía (Bucarest) y Portugal (Porto, Guimarães, Coimbra, Aveiro y Lisboa). Ha sido evaluador de proyectos de investigación en la Agencia Estatal de Investigación de España y en la Organización de Estados Iberoamericanos (OEI). Como experto europeo en Geografía ha participado en reuniones de la Comisión Europea en Italia y Bélgica. Impulsor y primer coordinador del proyecto europeo URBACT, "come Ourense", dentro del Programa de la Unión Europea "Sostenibilidad alimentaria en comunidades urbanas" (2012-2014). Dentro de la experiencia en organización de actividades de I+D+i se pueden destacar la organización de diferentes reuniones científicas desarrolladas dentro de la Asociación de Geógrafos Españoles (en 2002, 2004, 2012 y 2018).

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