

# Oregano essential oil: effect on sensory acceptability

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## Abstract

**Purpose** – This paper aimed to evaluate sensory acceptability of salad dressing formulated with different quantities of oregano essential oil (OEO) and salt as a starting point for the use of the spice as a natural preservative in food.

**Design/methodology/approach** – Sensory assessment of salad dressing with OEO was evaluated in relation to the following attributes: appearance, aroma, consistence, flavour and overall acceptability. Five formulations were developed with variation in the levels of OEO and sodium chloride through a 22 factorial design with a central point. A nine-point hedonic scale was used, besides purchase intent by a structured five-point scale.

**Findings** – There was no significant difference in the acceptance of the samples. Cluster analysis showed that formulation with intermediate quantities of salt and OEO was preferred by the consumers. OEO salad dressings with low salt content, regardless of OEO amount, presented higher intention to purchase.

**Research limitations/implications** – Due to an increasing interest in the use of natural preservatives to replace chemical additives, this study provided a starting point for further investigations concerning sensory acceptability of OEO in food.

**Practical implications** – Finding the balance between pleasant flavour and significant reduction of the use of salt in foods for dietary reasons is a complex challenge. Furthermore, studies need to be performed concerning interaction between amounts of essential oils and salt.

**Originality/value** – This study provides insights that suggest a promising usage of OEO in food.

**Keywords** Sensory evaluation, Multidimensional scaling, Essential oil, Oregano, Spice

**Paper type** Research paper



## Introduction

Due to the increasing public demand for healthy food and quality, government agencies from various countries are led to adopt increasingly effective legislative measures regarding food safety. Consequently, there is a broad research interest in the search for alternatives to chemical additives for rational use as food preservatives (Ivanovic *et al.*, 2012). The growing interest in the use of spices, evidenced in several studies, shows how

mainstream is the consumption of food in its most natural form (Viuda-Martos *et al.*, 2010; Cattelan *et al.*, 2013), generated by an incessant questioning about the safety of using chemical additives and reduced levels of salt in food for dietary reasons, which tends to increase the use of other flavourings (WHO, 2002; Burt, 2004).

Essential oil and natural extracts are used to extend the shelf life and improve lipid stability of foods (Mohamed and Mansour, 2012). In addition, some plants, their extracts, oils and/or active ingredients have well-documented antibacterial activity (Özcan and Erkmen, 2001; Ushimaru *et al.*, 2007; Yossa *et al.*, 2010; Castilho *et al.*, 2012; Cattelan *et al.*, 2013). Among the ones with known antibacterial and antioxidant action, phenolic compounds can be highlighted. According to Bonfanti *et al.* (2012), the genus *Origanum* is widespread in the Mediterranean area, with the use of oregano as seasoning. Among 70 varieties of spice, *Origanum vulgare* L. is highlighted, being used as a seasoning by the industry, in the production of spirits and in the pharmacological field. There are reports of utilization of oregano essential oil (OEO) as a dietary supplement to fight infections and to relieve for digestive and skin-related problems (Cho *et al.*, 2012). The four major components of OEO in percentage of content are the phenolic compounds carvacrol and thymol, and  $\rho$ -cymene and terpinene (Goulas and Kontominas, 2007), monoterpenes hydrocarbons. Carvacrol is usually reported as the major component of the OEO. It is a hydrophobic phenolic compound, with well-documented antimicrobial activity against bacteria, fungi and yeasts (Burt, 2004; Guarda *et al.*, 2011), and antioxidant activity (Baser, 2008), showing a high potential to promote the extension of the shelf life and safety of food products (Rubilar *et al.*, 2013).

Due to the intense aroma of oregano, one option is the use of essential oil in food matrices to provide a balance between sensory acceptability and properties exerted by spice (Azeredo *et al.*, 2011; Bonfanti *et al.*, 2012). Although there are several studies evidencing extremely important results regarding to the use of essential oils with potential antimicrobial and antioxidant, studies about combined effects of these oils and salting in food matrices are scarce (Frangos *et al.*, 2010).

The investigation of the action of bioactive compounds from OEO and its interaction with other factors should come from foods with simple arrays as salad dressing that, in turn, are oil-in-water emulsions that can easily undergo oxidation during processing or throughout the storage period (Tseng and Zhao, 2013). Thus, it is of paramount importance the use of spices to enhance microbiological stability to reduce the use of chemical additives for food preservation. Due to the great potential of the usage of OEO in commercially food matrices, the aim of this study was to evaluate the sensory acceptability for salad dressings formulated with different quantities of OEO and salt.

## Materials and methods

### Material

Raw material was purchased from the local market of São José do Rio Preto, São Paulo State, Brazil, for the preparation of OEO salad dressing: soybean oil (Vila Velha – Louis Dreyfus Commodities Brasil), soy protein powder (Mãe Terra Produtos Naturais Ltd.), whole milk powder (Itambé Alimentos Corporation), sodium chloride (Lebre – Norte Salineira Corporation), OEO (Laszlo Aromatherapy Ltd.) and mineral water.

*Salad dressing processing*

The mineral water (30.53 g), whole milk powder (3.8 g), soybean oil (64.12 g) and soy protein powder (1.55 g) were constantly stirred with the aid of a mixer at low speed. The OEO and the sodium chloride (independent variables) were added at the end of preparation of the mixture, to observe the variations of these ingredients in each formulation, as described in the experimental design shown in **Table I**, which was a  $2^2$  factorial design with a central point among the factors studied. The dependent variables for the experimental design were the sensory acceptability by appearance, aroma, consistence, flavour and overall acceptability.

*Sensory assessment*

The ethical issues of the sensory analysis were approved by the Research Ethics Committee of the Institute of Biosciences, Humanities and Exact Sciences, São Paulo State University (Opinion Report 42,100), and the intolerance of the consumers to any of the components of the product formulation condiment constituted an exclusion criterion.

The sensory assessment was carried out with the five formulations of salad dressings to study the influence of OEO and sodium chloride in sensory acceptability. Salad dressings were evaluated by 60 untrained consumers (76.6 per cent female and 23.3 per cent male, aged 18-52 years and averaging 25 years) at the Laboratory of Sensory Analysis, Department of Food Engineering and Technology, Institute of Biosciences, Literature and Exact Sciences, São Paulo State University. The sensory analysis was carried out in individual booths, under white light and temperature from 23 to 25°C.

First, the consumers answered a questionnaire characterization, indicating gender, age and frequency of consumption of salad dressing in general. After that, the consumers evaluated all the five samples of salad dressings (**Table I**) regarding appearance, aroma, consistence, flavour and overall acceptability, using a nine-point verbal hedonic scale (1 = disliked extremely, 5 = neither liked nor disliked and 9 = liked extremely) (Meilgaard *et al.*, 1999), besides purchase intent of the samples by a structured five-point scale (1 = certainly not buy, 3 = I doubt it would buy to 5 = certainly buy).

One tea spoon of each salad dressing was served over a toast, and water for cleansing the palate between assessments was provided. Samples were presented to consumers in

**Table I.**  
Experimental design  
with encoded and  
real values of the  
independent  
variables used in  
each salad dressing  
formulation

Formulation	Encoded variables		Real variables	
	X <sub>1</sub>	X <sub>2</sub>	Salt (%)	OEO concentration (%) <sup>a</sup>
1	-1	-1	1.14	0.2
2	+1	-1	1.30	0.2
3	0	0	1.22	0.3
4	-1	+1	1.14	0.4
5	+1	+1	1.30	0.4

**Notes:** <sup>a</sup>Percentages of OEO and salt in relation to 100 g of mixture of mineral water, whole milk powder, soybean oil and soy protein powder (weight/weight)

a monadic and randomized complete block design, coded with random three-digit numbers.

#### Statistical analysis

Sensory acceptability for the samples, regarding appearance, aroma, consistence, flavour and overall acceptability, was evaluated using descriptive statistics and application of analysis of variance. Purchase intent was assessed using a graphical frequency chart. Possible correlation between the sensory attributes in each of the formulations was checked by means of Pearson's correlation test, and it was considered a strong correlation any coefficient higher than 0.70 and with  $p$ -value lower than 0.05 (Leighton *et al.*, 2010).

Additionally, the results of sensory acceptability were evaluated by multivariate analysis, applying cluster analysis, followed by multidimensional scaling with the objective of verifying the willingness of consumers in relation to the acceptability of the samples of OEO salad dressing.

The significance level of all statistical tests was 0.05, using Statistica<sup>®</sup>, version 7.0.61.0 (Statistica, 2004).

#### Results and discussion

Regarding to product consumption, it was observed that most of the consumers consume salad dressings at least twice a week (22 to 36.7 per cent), followed by rarely (19 to 31.7 per cent), monthly (13 to 21.7 per cent), weekly (5 to 8.3 per cent) and daily (1 to 1.7 per cent).

The ranges of sensory liking for the OEO salad dressings were: 7.0 to 7.6 to appearance, 6.1 to 6.4 for aroma, 6.9 to 7.4 for consistence, 5.6 to 6.2 for flavour and 6.2 to 6.7 for overall acceptability (Table II). All models constructed for explaining the effects of OEO and salt on sensory acceptability showed lack of fit, probably because all sensory attributes of the salad dressings were equally liked, as well the overall acceptability (Table II). The overall acceptability presented average ranged between "liked slightly" (6) to "liked moderately" (7), similar to results reported by Azeredo *et al.* (2011) for sensory acceptability of sanitized vegetables with OEO ranging between "like slightly" to "neither liked nor disliked" in a hedonic scale.

In all formulations, it was possible to find strong correlations ( $p \leq 0.05$ ) of flavour attribute with overall acceptability (F1:  $r = 0.91$ ; F2:  $r = 0.84$ ; F3:  $r = 0.87$ ; F4:  $r = 0.85$ ; F5:  $r = 0.83$ ), suggesting that the flavour was the attribute that was directly correlated with overall acceptability of the samples. In the sample, F4 was possible to verify a significant correlation between appearance and consistence ( $r = 0.71$ ;  $p \leq 0.05$ ), showing that the appearance exerted some influence in the wider acceptability of consistence for the sample.

Cluster analysis for aroma liking formed two groups: one group with formulation F5 (35 consumers) and the other group with formulations F1, F2, F3 and F4 (25 consumers) [Figure 1(a)]. Samples from the same group were evaluated in similar ways by the consumers. The two clusters formed allocate consumers near the null value for both dimensions studied. It should be noted that despite the marked aroma of OEO, this was not found unpleasant by the consumers. Viuda-Martos *et al.* (2010) have demonstrated that the addition of essential oils (oregano and thyme) to bologna sausages was not found a disagreeable aroma by the panelists.

Attributes	Formulation <sup>a</sup>	Mean (SD)	Median	<i>p</i> -value of ANOVA
Appearance	F1	7.5 (0.9)	8.0	0.064
	F2	7.4 (1.2)	8.0	
	F3	7.6 (1.1)	8.0	
	F4	7.0 (1.3)	7.0	
	F5	7.1 (1.3)	7.0	
Aroma	F1	6.3 (1.2)	6.0	0.773
	F2	6.1 (1.2)	6.0	
	F3	6.2 (1.2)	6.0	
	F4	6.2 (1.2)	6.0	
	F5	6.4 (1.3)	6.0	
Consistence	F1	7.3 (1.2)	7.0	0.321
	F2	7.2 (1.3)	7.0	
	F3	7.4 (1.2)	8.0	
	F4	6.9 (1.4)	7.0	
	F5	7.1 (1.3)	7.0	
Flavour	F1	6.2 (1.9)	7.0	0.275
	F2	5.7 (2.0)	6.0	
	F3	6.0 (1.7)	6.0	
	F4	6.2 (1.7)	7.0	
	F5	5.6 (2.2)	6.0	
Overall acceptability	F1	6.7 (1.4)	7.0	0.321
	F2	6.3 (1.4)	6.0	
	F3	6.5 (1.4)	7.0	
	F4	6.5 (1.5)	7.0	
	F5	6.2 (1.5)	6.5	

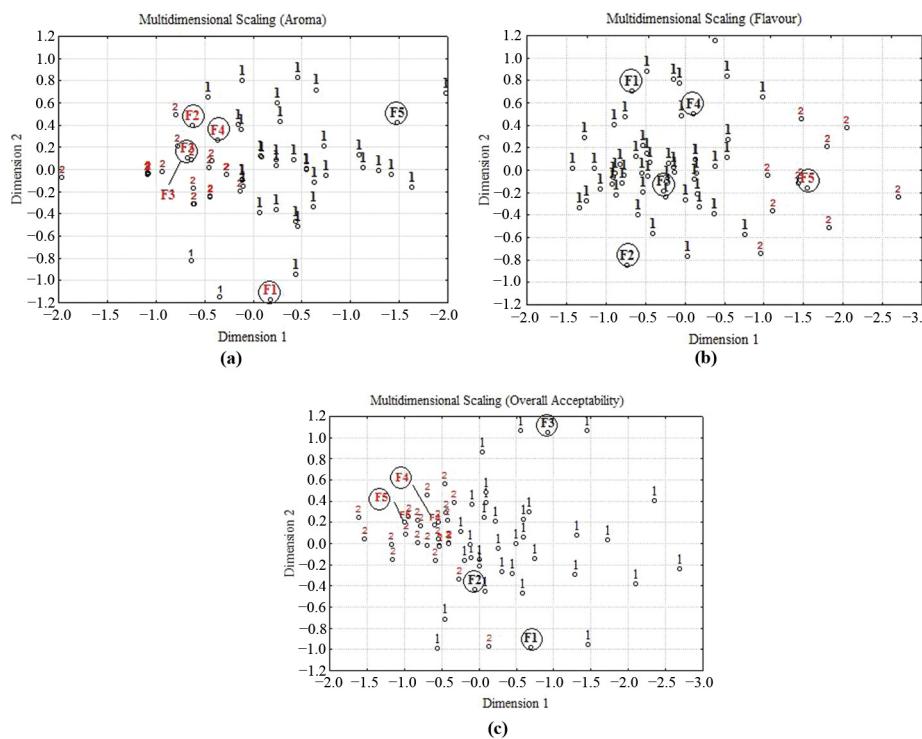
**Table II.**  
Acceptability of the  
OEO salad dressing  
formulations

**Notes:** <sup>a</sup>F1, F2, F3, F4 and F5: formulations 1 to 5 correspond to each formulation of OEO salad dressing containing different amounts of OEO and salt. F1 = 1.14% salt and 0.2% of OEO; F2 = 1.3% salt and 0.2% of OEO; F3 = 1.22% salt and 0.3% of OEO; F4 = 1.14% salt and 0.4% of OEO; and F5 = 1.3% salt and 0.4% of OEO

The cluster analysis for flavour liking resulted in two groups of formulations: Cluster 1 formed by F1, F2, F3 and F4 samples (50 consumers), indicating a higher liking for these formulations, and Cluster 2 formed by the sample F5 (10 consumers), formulation with higher contents of salt and OEO [Figure 1(b)]. In a study about the use of OEO in cod fish roe, [Mexis et al. \(2009\)](#) showed that concentrations of 0.1 per cent (v/w) of essential oil provided a strong flavour, as described by panelists.

Regarding the overall acceptability, it was possible to verify the formation of also two clusters: one group with formulations F1, F2 and F3 (34 consumers) and other group formed by formulations F4 and F5 (26 consumers) [Figure 1(c)], although quantity of consumers was very similar between two groups.

Samples F1, F3 and F4 had high intention to be purchased, while F5 had high intention to not be purchased (Figure 2). This suggests that oregano salad dressings with lower concentrations of salt, independent of OEO content, had greater purchase intention. The combination of higher levels of OEO and salt (F5) responds in a negative way to the acceptability of salad dressings. Similar results were reported by [Azeredo et al. \(2011\)](#) when consumers were asked about their intention to purchase vegetables



**Notes:** (a) Aroma, (b) flavour and (c) overall acceptability. F1, F2, F3, F4 and F5 formulations 1 to 5 correspond to each formulation of OEO salad dressing containing different amounts of OEO and salt. F1 = 1.14 per cent salt and 0.2 per cent of OEO; F2 = 1.3 per cent salt and 0.2 per cent of OEO; F3 = 1.22 per cent salt and 0.3 per cent of OEO; F4 = 1.14 per cent salt and 0.4 percent of OEO; and F5 = 1.3 per cent salt and 0.4 per cent of OEO

treated with essential oils of oregano and rosemary, indicating similar results between the possible purchase and indecision for buying vegetables.

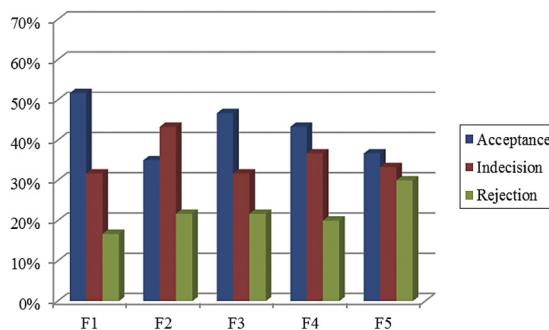
Olmedo *et al.* (2013) reported that essential oils have a new opportunity in food processing because of the green labelling and natural image. Although, essential oils have some drawbacks, including interference with sensory properties, adjustments in the formulation of OEO salad dressings are required to provide a more balanced formulation and result in a more palatable product when OEO and sodium chloride are combined. Finding the balance between pleasant flavour and significant reduction of the use of sodium chloride in foods for dietary reasons is a great challenge. Moreover, it tends to increase the use of other substances that impart flavour to foods as essential oils, which are usually recognized as safe by the FDA – US Food and Drug Administration (Rubilar *et al.*, 2013).

## Conclusion

Variations in the concentrations of OEO and sodium chloride did not produce significant effects in the liking for salad dressings. However, considering the cluster analyses and

**Figure 1.**  
Distribution of panelists in the multidimensional space according to the sensory attributes of OEO salad dressing

**Figure 2.**  
Percentage distribution of intent to purchase the samples of OEO salad dressing



**Notes:** F1, F2, F3, F4 and F5: formulations 1 to 5 correspond to each formulation of OEO salad dressing containing different amounts of OEO and salt. F1 = 1.14 per cent salt and 0.2 per cent of OEO; F2 = 1.3 per cent salt and 0.2 per cent of OEO; F3 = 1.22 per cent salt and 0.3 per cent of OEO; F4 = 1.14 per cent salt and 0.4 per cent of OEO; and F5 = 1.3 per cent salt and 0.4 per cent of OEO

purchase intent, salad dressing containing 1.22 per cent of salt and 0.3 per cent of OEO (formulation 3, with intermediate quantities of salt and OEO) stood in relation to flavour and overall liking, besides purchase intent. Finally, we conclude that finding the balance between pleasant flavour and significant reduction of the use of sodium chloride in foods for dietary reasons is a great challenge, which was partially reached in this work.

## References

Azeredo, G.A., Stamford, T.L.M., Nunes, P.C., Gomes Neto, N.J., Oliveira, M.E.G. and Souza, E.L. (2011), "Combined application of essential oils from *Origanum vulgare L.* and *Rosmarinus officinalis L.* to inhibit bacteria and autochthonous microflora associated with minimally processed vegetables", *Food Research International*, Vol. 44 No. 5, pp. 1541-1548.

Baser, K.H.C. (2008), "Biological and pharmacological activities of carvacrol and carvacrol bearing essential oils", *Current Pharmaceutical Design*, Vol. 14 No. 29, pp. 3106-3120.

Bonfanti, C., Ianni, R., Mazzagli, A., Lanza, C.M., Napoli, E.M. and Ruberto, G. (2012), "Emerging cultivation of oregano in sicily: sensory evaluation of plants and chemical composition of essential oils", *Industrial Crops and Products*, Vol. 35 No. 1, p. 160-165.

Burt, S. (2004), "Essential oils: their antimicrobial properties and potential applications in foods - a review", *International Journal of Food Microbiology*, Vol. 94 No. 3, pp. 223-253.

Castilho, P.C., Savluckinske-Feio, S., Weinholt, T.S. and Gouveia, S.C. (2012), "Evaluation of the antimicrobial and antioxidant activities of essential oils, extracts and their main components from oregano from Madeira Island, Portugal", *Food Control*, Vol. 23 No. 2, pp. 552-558.

Cattelan, M.G., Castilhos, M.B.M., Sales, P.J.P. and Hoffmann, F.L. (2013), "Antibacterial activity of oregano essential oil against foodborne pathogens", *Nutrition & Food Science*, Vol. 43 No. 2, pp. 169-174.

Cho, S., Choi, Y., Park, S. and Park, T. (2012), "Carvacrol prevents diet-induced obesity by modulating gene expressions involved in adipogenesis and inflammation in mice fed with high-fat diet", *Journal of Nutritional Biochemistry*, Vol. 23 No. 2, pp. 192-201.

Frangos, L., Pyrgotou, N., Giatrakou, V., Ntzimani, A. and Savvaidis, I.N. (2010), "Combined effects of salting, oregano oil and vacuum-packaging on the shelf-life of refrigerated trout fillets", *Food Microbiology*, Vol. 27 No. 1, pp. 115-121.

Goulas, A.E. and Kontominas, M.G. (2007), "Combined effect of light salting, modified atmosphere packaging and oregano essential oil on the shelf-life of sea bream (*Sparus aurata*): biochemical and sensory attributes", *Food Chemistry*, Vol. 100 No. 1, p. 287-296.

Guarda, A., Rubilar, J.F., Miltz, J. and Galotto, M.J. (2011), "The antimicrobial activity of microencapsulated thymol and carvacrol", *International Journal of Food Microbiology*, Vol. 146 No. 2, p. 144-150.

Ivanovic, J., Misic, D., Zizovic, I. and Ristic, M. (2012), "*In vitro* control of multiplication of some food-associated bacteria by thyme, rosemary and sage isolates", *Food Control*, Vol. 25 No. 1, pp. 110-116.

Leighton, C.S., Schonfeldt, H.C. and Kruger, R. (2010), "Quantitative descriptive sensory analysis of five different cultivars of sweet potato to determine sensory and texture profiles", *Journal of Sensory Studies*, Vol. 25 No. 1, pp. 2-18.

Meilgaard, M., Civille, G.V. and Carr, B.T. (1999), *Sensory Evaluation Techniques*, CRC Press, Boca Raton, FL.

Mexis, S.F., Chouliara, E. and Kontominas, M.G. (2009), "Combined effect of an O<sub>2</sub> absorber and oregano essential oil on shelf-life extension of Greek cod roe paste (tarama salad) stored at 4°C", *Innovative Food Science Emerging Technologies*, Vol. 10 No. 4, pp. 572-579.

Mohamed, H.M.H. and Mansour, H.A. (2012), "Incorporating essential oils of marjoram and rosemary in the formulation of beef patties manufactured with mechanically deboned poultry meat to improve the lipid stability and sensory attributes", *Food Science and Technology – LWT*, Vol. 45 No. 1, pp. 79-87.

Olmedo, R.H., Nepote, V. and Grosso, N.R. (2013), "Preservation of sensory and chemical properties in flavoured cheese prepared with cream cheese base using oregano and rosemary essential oils", *Food Science and Technology – LWT*, Vol. 53 No. 2, pp. 409-417.

Özcan, M. and Erkmen, O. (2001), "Antimicrobial activity of the essential oils of Turkish plant splices", *European Food Research and Technology*, Vol. 212 No. 6, pp. 658-660.

Rubilar, J.F., Cruz, R.M.S., Silva, H.D., Vicente, A.A., Khmelinskii, I. and Vieira, M.C. (2013), "Physico-mechanical properties of chitosan films with carvacrol and grape seed extract", *Journal of Food Engineering*, Vol. 115 No. 4, pp. 466-474.

Statistica (2004), *Data Analysis Software System (version 7.0.61.0)*, Stat Soft, Tulsa.

Tseng, A. and Zhao, Y. (2013), "Wine grape pomace as antioxidant dietary fibre for enhancing nutritional value and improving storability of yogurt and salad dressing", *Food Chemistry*, Vol. 138 No. 1, pp. 356-365.

Ushimaru, P.I., Silva, M.T.N., Di Stasi, L.C., Barbosa, L. and Fernandes Júnior, A. (2007), "Antibacterial activity of medical plant extracts", *Brazilian Journal of Microbiology*, Vol. 38, pp. 717-719.

Viuda-Martos, M., Ruiz-Navaja, Y., Fernández-López, J. and Pérez-Alvarez, J.A. (2010), "Effect of orange dietary fibre, oregano essential oil and packaging conditions on shelf-life of bologna sausages", *Food Control*, Vol. 21 No. 4, pp. 436-444.

World Health Organization (WHO) (2002), "World health report 2002: reducing risks, promoting healthy life", available at: [www.who.int/whr/2002/en/](http://www.who.int/whr/2002/en/) (accessed 21 September 2012).

Yossa, N., Patel, J., Miller, P. and Martin Lo, Y. (2010), "Antimicrobial activity of essential oils against *Escherichia coli* O157:H7 in organic soil", *Food Control*, Vol. 21 No. 11, pp. 1458-1465.

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