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Nutritional data evaluation study on rose petals, ginger root and lemon

Laura Rădulescu (Corpaș)[1], Despina-Maria Bordean[1*], Nicoleta G. Hădărugă[1], Corina Iuliana Megyesi[1], Alexandru Erne Rinovetz[1]

[1]Faculty of Food Engineering, Banat's University of Agricultural Sciences and Veterinary Medicine „King Michael I of Romania" from Timisoara, Calea Aradului 119, Timisoara, RO 300645, Romania
[2]Research Center for"Food Science", Faculty of Food Engineering, Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" – Timișoara, Calea Aradului 119, 300645 – Timișoara, Romania

Abstract

The aim of this study was to evaluate the nutritional profiles of rose petals, lemons, and ginger roots. Rose flowers are used to make various cream or mousse, they can be combined with various fruit juices, salads, jams or desserts, drinks such as lemonade, orange juice, to give a more exotic note. These flowers have very important nutritional characteristics and they can provide special sources of bioactive compounds.The bioactivity of lemon fruits has a bioactivity given by the high content of flavonoids and also of diosmin, limocitrin and phenolic acids, p-hydroxybenzoic, ferulic, synaptic acids, coumarins, hesperidin, amino acids, vitamins and minerals.Volatile oils as well as an oleoresin are found in the ginger rhizome in a percentage between 1% -4%. Lemon in combination with ginger root are described as having great nutritional value, and in combination with rose petals and high quality honey, they can provide a valuable sweetness of rose petals that can be a valuable functional food. The rose petals jam described by this study offers to the consumer a delicious taste and a nutritional profile described by high content of minerals, vitamins as well as proteins and fibers.

Keywords: functional food, rose petals jam, generalized linear model.

1. Introduction

A common definition of functional food is "processed foods having disease-preventing and/or health-promoting benefits in addition to their nutritive value". Mainly the term functional foods overlap with nutraceuticals, pharmafoods, and vitafoods [1]. The aim of the study was to evaluate the nutritional profiles of rose petals, ginger roots and lemons in order to obtain a rose petals jam with optimized properties.

Rose (*Rosa*) is indigenous to Asia, one of the most trendy flower in the world according to some studies date its emergence to more than 5,000 years ago. Roses belong to the *Rosaceae* family, *Rosa* genus, with more than hundred species [2]. Rose flowers are used in Arabic gastronomic and can be eaten in various creams, mousses, can be combined with fruit juices, desserts, salads, jams, to give an exotic note [3]. Without the "glam" factor, edible flowers also have very important nutritional characteristics and can provide sources of bioactive compounds [5]. From the point of view of the chemical composition of rose petals, they contain a significant amount of volatile oils, citronellol, flavonic derivatives, quercitin, geraniol, anthocyanin dyes, quercitin, cyanine and last but not least significant amounts of tannin [6]. Rose petals are very rich in minerals and vitamins regenerate the skin, they can also be used to fight deterrent forms of flu and colds, but also digestive problems, given that it releases the body of toxins, because they have an anti-inflammatory effect, analgesic, calming, antipyretic, healing properties and last but not least diuretic properties [4]. The use of these rose flowers was not only for decorative purposes, some species can be used as wildlife food, while other species have phytotherapeutic properties and produce essences and oils that are used in cosmetics, perfumery or are used in cooking [7].

Corresponding authors: despinabordean@usab-tm.ro

Lemon (*Citrus limon*) is the name of the fruit tree of the genus Citrus, which is part of the Rutacea family and its fruits. The name "lemon" comes from the Malaysian "lemo". In India, the fruit of the lemon tree is called "nimbu", and in China - "limung" [8]. A single fruit provides the body with a daily amount of vitamin C, which is extremely important for immunity. In addition to vitamin C, lemon comes with a high intake of vitamin A, B6, E, folic acid, pantothenic acid, thiamine, calcium, copper, iron, magnesium, phosphorus, lutein, selenium and zinc. It contains a mixture of organic acids as well as essential oils in the pulp of the fruit and in the peel there is a very good and effective antiseptic [9]. The bioactivity of the lemon fruits is given by the high content of flavonoids like diosmin, hesperidin, limocitrin and phenolic acids like p-hydroxybenzoic, synapic and ferulic acids, coumarins, amino acids, minerals and vitamins [10]. Eating foods rich in ascorbic acid (vitamin C) helps strengthen resistance to infectious agents and cleanses free radicals from the blood. The consumption of lemons as fruits, juice or added in different foods is recommended by the numerous health benefits (anticancer, anti-inflammatory, antibacterial, antifungal, antiviral and anti-allergic, hepato-regenerative, anti-obesity activities). Other biological activities of lemon extracts confirmed by different research studies are prevention of diabetes and treatment of its symptoms [11], on the nervous system [13], on the respiratory system [14], and on the skeletal system [10].

Ginger (*Zingiber officinale* Roscoe) is a perennial plant belonging to the family *Zingiberaceae*, being grown mostly in Asia and the tropics. It is one of the most important and widely consumed plants in the world. Cultivated for the edible underground stem (rhizome), ginger has been used since ancient times both as a spice and as an herbal medicine to treat diseases, mostly gastrointestinal, such as vomiting (emesis), nausea, dyspepsia, diarrhea, as well. various diseases, including muscle aches, fever and arthritis [15]. Ginger rhizome contains a wide variety of biologically active secondary metabolites. The rhizome contains about 1% -4% volatile oils as well as an oleoresin [16]. The distinctive aroma and smell of ginger is mainly due to volatile oils and usually to non-volatile phenolic compounds, which have pungent properties [17]. The volatile oils that are extracted with steam consist mainly of sequiterpene hydrocarbons, predominantly mostly ginger, which gives rise to the aroma that characterizes ginger. The non-volatile phenolic phytochemicals of ginger consist of gingeroli, shogaoliparadoli, and ginger, and about 30 gingerol-related compounds can be fractionated from raw ginger. Gingerols are part of a series of chemical homologues differentiated by the length of their unbranched (n6 – n12) alkyl chains. Of all these gingerols, 6-gingerol is the best phytochemically investigated ginger [18]. Ginger is used in a variety of forms, including fresh, pickled, crystallized, canned, dried, candied, and powdered. Presentations may include capsules, tablets, tinctures, teas and liquid extracts. Usually, the concentrations of active ingredients (gingeroli and shogaoli) will differ between the various preparations and the processing steps involved. Gingerols are thermally labile, and the degree of conversion of gingerol to shogaol will have a very considerable impact on the medicinal benefits, as these two compounds vary in bioavailability and pharmacological properties [19].

2.Materials and methods

For the study case were used over 100 selected research papers as well as USDA nutritional database. The rose petals jam was prepared based onan optimized recipe by adding minced ginger root and lemon. The quantities of lemon and ginger were established according to the mathematical models. For sweetening the jam were used 120 g ecological polyflower honey.The nutritional values of rose petals, ginger and lemon were analyzed using PAST statistical program [20].

3.Results and discussions

The study evaluates the nutritional values of rose petals, ginger and lemons and answers the question regarding optimizing a rose petals jam in order to produce functional food. The data collected from the research papers and databases are presented in table 1 and figure 1. All the nutritional values are presented as per 100 grams fresh matter.

Table 1. Nutritional values of main rose jam compounds

Nutritional compounds	**U.M**	**Lemon nutrient value/ 100 g fresh matter**	**Ginger nutrient value / 100 g fresh matter**	**Roses nutrient value / 100 g fresh matter**
Energy	kcal	29.00 [21]	75.00 [25]	278.00 [24]
Moisture	g	88.00 [22]	81.30 [23]	68.00 [24]
Carbohydrates	g	9.32 [21]	17.77 [25]	68.00 [24]
Total fat	g	0.30 [21]	0.65 [25]	0.00 [24]
Dietary fiber	g	2.80 [21]	3.00 [25]	0.00 [24]
Proteins	mg	1.10 [21]	1.82 [25]	-
Raw fiber	g	2.80 [21]	2.00 [25]	0.00 [24]
Folic acid	µg	11.00 [21]	12.00 [25]	-
Thiamine (B1)	mg	0.04 [21]	0.03 [25]	-
Riboflavin (B2)	mg	0.02 [21]	0.03 [25]	-
Niacin (B3)	mg	0.10 [21]	0.75 [25]	-
Pantothenic acid (B5)	mg	0.19 [21]	0.20 [25]	-
Pyridoxine (B6)	mg	0.08 [21]	0.16 [25]	-
C vitamin	mg	53.00 [21]	5.00 [25]	2.00 [26]
Vitamin A	IU	22.00 [21]	0.00 [25]	-
Vitamin E	mg	0.15 [21]	0.26 [25]	-
Vitamin K	µg	0.00 [21]	0.10 [25]	-
Sodium	mg	2.00 [22]	13.00 [25]	7.92 [27]
Potassium	mg	138.00 [22]	415.00 [25]	203.34 [27]
Calcium	mg	26.00 [22]	16.00 [25]	28.56 [27]
Copper	µg	37.00 [22]	0.23 [25]	0.23 [27]
Iron	mg	0.60 [22]	0.60 [25]	0.40 [27]
Magnesium	mg	8.00 [22]	43.00 [25]	14.25 [27]
Manganese	mg	0.03 [22]	-	0.34 [27]
Zinc	mg	0.06 [22]	0.34 [25]	0. 462 [27]
Phosphorus	mg	-	-	24.52 [27]

Figure 1 shows that both ginger and lemon increase the mineral composition and content of the jam but also the dietary fiber, protein content and vitamin content. All the nutritional values are presented as per 100 grams fresh matter.

The Bar chart representation (figure 2), constructed based on the logarithmic data of the nutritional values has the role to show us the components level, which are optimized when adding ginger and lemon. As we can see lemon is increasing the quantity of Zn, Cu and vitamins (A, B1, B2 and C) while the addition of ginger provides more Mg, Fe, vitamins (K, E, C, B3, B5, B6), folic acid, proteins, dietary fibers and total fat.

The role of the principal analysis is to prove the possibility of improving the nutritional value of a food product by introducing in the food recipe new components based on the need of the consumer. The principal component analysis (PCA) was performed using variance- covariance matrix with a Joliffe cut off = 1750.

The broken stick (figure 3), as well as the variance percents presented in table 2 recommend to use the distribution of data only on the principal components (PC 1 and 2).

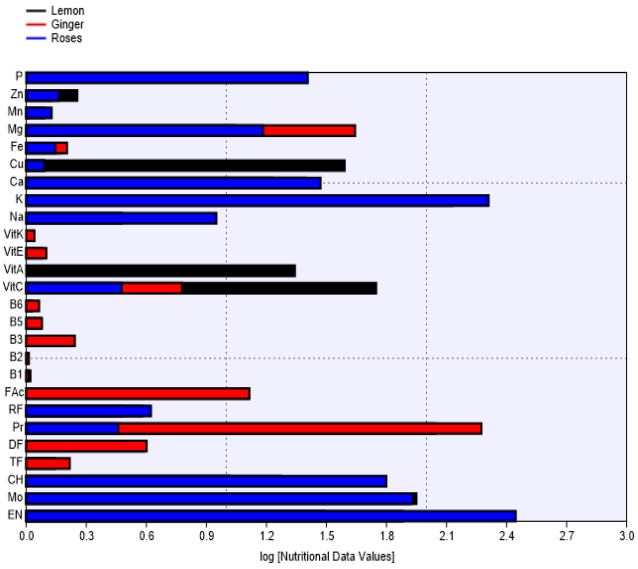


Figure 2. **Barchart graphical representation**
Legend: EN=Energy [kcal]; Mo=Moisture [g]; CH=Carbohydrates[g]; TF=Total fat[g]; DF=Dietary fiber[g]; Pr=Proteins[mg]; RF=Raw fiber[g]; FAc=Folic acid[µg]; B1=Thiamine [mg]; B2=Riboflavin [mg]; B3=Niacin[mg]; B5=Pantothenic acid [mg]; B6=Pyridoxine [mg]; VitC=C vitamin[mg]; VitA=Vitamin A[IU]; VitE=Vitamin E[mg]; VitK=VitaminK[µg]; Na=Sodium[mg]; K=Potassium[mg]; Ca=Calcium[mg]; Cu=Copper[µg]; Fe= Iron[mg]; Mg= Magnesium[mg]; Mn= Manganese[mg]; Zn= Zinc[mg]; P= Phosphorus[mg];

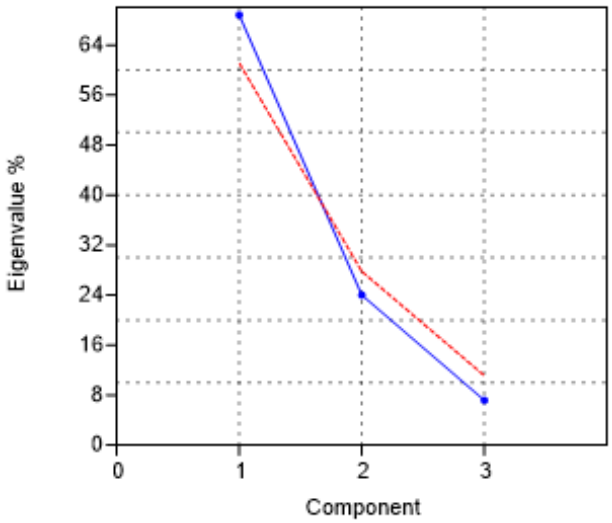


Figure 3. Broken stick graphical representation for PCA

The "Broken Stick model" is a method used for estimating the number of statistically important principal components [28]. The Eigen values and variance percents are presented in table 2.

Table 2. Principal component analysis of data

PC	Eigenvalue	% variance
1	5161.21	68.812
2	1801.1	24.013
3	538.172	7.1752

The PCA model representations show the presence of the vectors corresponding to the nutritional values of rose petals in the forth quadrant which recommends to use ginger root and lemon (first quadrant)as additional compounds in order to obtain a functional food product with higher nutritional value.

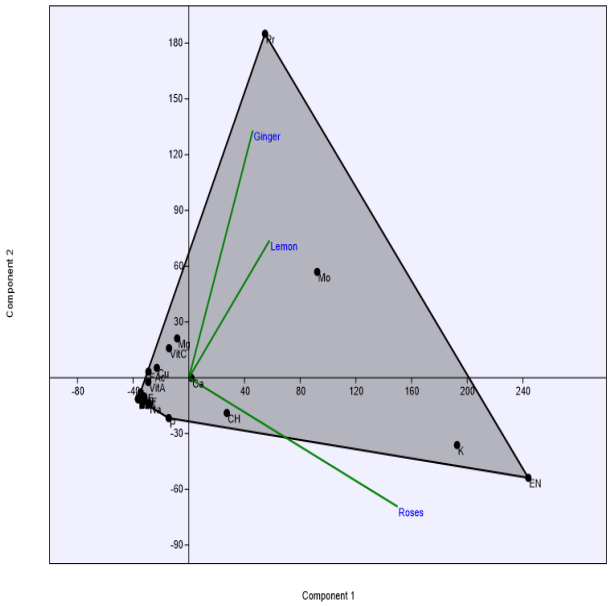


Figure 4. Graphical representation of PCA (Principal component analysis) of roses, lemon and ginger nutritional data values
Legend: EN=Energy [kcal]; Mo=Moisture [g]; CH=Carbohydrates[g]; TF=Total fat[g]; DF=Dietary fiber[g]; Pr=Proteins[mg]; RF=Raw fiber[g]; FAc=Folic acid[µg]; B1=Thiamine [mg]; B2=Riboflavin [mg]; B3=Niacin[mg]; B5=Pantothenic acid [mg]; B6=Pyridoxine [mg]; VitC=C vitamin[mg]; VitA=Vitamin A[IU]; VitE=Vitamin E[mg]; VitK=VitaminK[µg]; Na=Sodium[mg]; K=Potassium[mg]; Ca=Calcium[mg]; Cu=Copper[µg]; Fe= Iron[mg]; Mg= Magnesium[mg]; Mn= Manganese[mg]; Zn= Zinc[mg]; P= Phosphorus[mg];

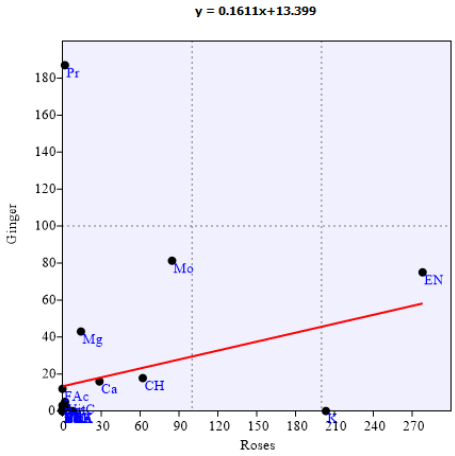
In order to reveal how ginger root and lemon will improve the quality of rose jam, we applied the generalized linear model (figure 5). In both situations, the mathematical model was applied using normal distribution and identity link function with phi estimate.

$$y_1=0.1611x +13.399$$

Where:

y_1 *= represent the influence of ginger nutritional values*

x *= represent the influence of roses nutritional values*



$$y_2=0.26952x +13.481$$

Where:

y_2 *= represent the influence of lemon nutritional values*

x *= represent the influence of roses nutritional values*

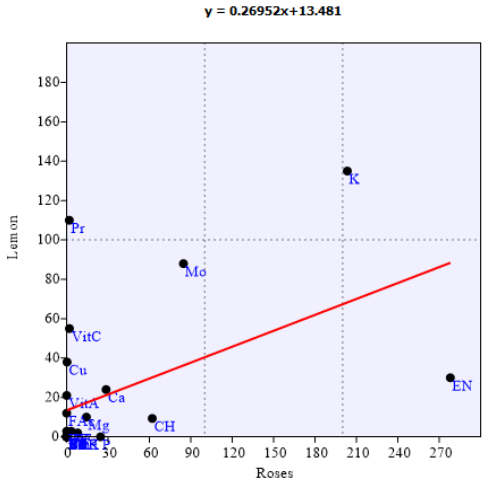


Figure 5. Influence of ginger and lemon on the roses jams nutritional values

Legend: EN=Energy [kcal]; Mo=Moisture [g]; CH=Carbohydrates[g]; TF=Total fat[g]; DF=Dietary fiber[g]; Pr=Proteins[mg]; RF=Raw fiber[g]; FAc=Folic acid[µg]; B1=Thiamine [mg]; B2=Riboflavin [mg]; B3=Niacin[mg]; B5=Pantothenic acid [mg]; B6=Pyridoxine [mg]; VitC=C vitamin[mg]; VitA=Vitamin A[IU]; VitE=Vitamin E[mg]; VitK=VitaminK[µg]; Na=Sodium[mg]; K=Potassium[mg]; Ca=Calcium[mg]; Cu=Copper[µg]; Fe= Iron[mg]; Mg= Magnesium[mg]; Mn= Manganese[mg]; Zn= Zinc[mg]; P= Phosphorus[mg];

By applying the equations recommended by the general linear models, we obtain the following: x=250 g rose petals, y_1 =53.67 g ginger root and y_2 = 87.28 g lemon.

4.Conclusions

Ginger root and lemon are described by great nutritional values which combined with rose petals and honey can offer valuable rose petals jam which can be recommended as a functional food. Based on the general model we can optimize the rose jam recipe by adding approximately 54-55 g of fresh ginger root and 88-90 g of fresh lemon for 250 g of rose petals. Honey or sugar will be added according to the desired sweet taste. The rose jam produced based on this recipe will show higher content of minerals like magnesium, manganese, potassium and molybdenum, vitamins, high level of proteins and fiber contents

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human or animal subjects (if exist) respect the specific regulation and standards.

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