COFFEE CAFFEINE EXPERTISE AND ITS EFFECTS ON NUTRITION AND CONSUMERS HEALTH

Steluța RADU[1]

e-mail: stelaradu2010@yahoo.com

Abstract

The experimental research looked at the side effects of coffee alkaloids on consumer nutrition. Most coffee drinkers do not know the side effects of alkaloids in that, especially caffeine. On the other hand, from a nutritional point of view, the higher the caffeine content, the higher the mineral content. So, the permissible dose limit of caffeine, an exciting nerve cell alkaloid, LD50 of 200 mg caffeine / 100 g of coffee, induces a better state of comfort, concentration and better energy level, because when the amount of coffee used to prepare a coffee, increases the level of minerals, although the benefits of coffee consumption disappear. The experimental results obtained show that at caffeine concentrations of 200 mg / 100 g coffee the permissible limit level, the concentration in mineral substances is 692.1 mg for Arabica coffee and 391.5 mg for Robusta coffee. The LD50 limit of 200 mg / 100 g of caffeine means 3 and a half doses for Arabica coffee and 2 doses for Robusta coffee. In conclusion, what exceeds this number of doses, i.e. between 225-300 mg / 100 g caffeine, 4-5 doses, a concentrated coffee, means a consumption of coffee with harmful effects on the body, even if the human metabolism requires it due to a significant intake of mineral salts of 7.94% for Robusta coffee and 13.88% for Arabica coffee compared to the recommended daily dose DZR.

Key words: caffeine effects vs. mineral salts

Most of the authentication and expertise according to the geographical origin regarding the origin of coffee, highlights the fact that the Arabica assortment comes from Sudan and Ethiopia, and the Robusta assortment from West Africa. The taste is what differentiates the two varieties: Arabica coffee is more aromatic and sweeter, while Robusta coffee is more bitter. Another differentiation is the shape of the grain. The Robusta coffee bean is smaller and rounder, while the Arabica coffee bean is larger and more oval (Fleancu C., 2020) Over time, scientists have closely studied coffee beans, today there is a wealth of information covering the technological processing chain of coffee. For coffee tree growers and processors around the world, coffee is the basis of their existence, and for this reason, both they and the coffee tree culture had to cope with all diseases, climate change, social unrest, but also various demand. There are organizations that have come to the aid of farmers, trying to find the link between microbiology, genetics and agriculture to improve coffee production. In the laboratories, researchers gather information on the extraction of flavor from each bean, secrets of roasting and grinding, decaffeination and the influence of water quality used for coffee. The value of coffee increases through the consumer's knowledge of the origin, processing, durability and diversity of flavour. (Folmer B, 2017). Arabica and Robusta were planted together to produce new genetically similar varieties (hybrids). The ripening period varies from individual to individual, for example Arabica beans ripen in six to eight months, and Robusta beans need nine to eleven months to ripen. The aroma of coffee beans may differ depending on the region where the plant was grown, for this reason, coffee specialists can determine the origin of coffee by smell, taste, acidity and shape of the bean. The *Rubiaceae* family includes: *Liberica*, *Excelsa*, *Arabica* and *Robusta*. Of these four species, only Robusta and Arabica are marketed. (Frisks J, 2016). The quality of the coffee is given by the appearance of freshly picked and roasted beans, aroma, acidity and the processing methods applied. From the composition of green and roasted coffee beans it results that the lipid content is higher in Arabica coffee (18-20%), compared to Robusta coffee (13-16%), the protein content is the same (11-15 %), caffeine registers values of 1 to 2% in roasted coffee, and the concentration in chlorogenic acid (g/100g) is higher in Robusta coffee 7-10 g / 100g compared to 5.5-8 g / 100g. The amount of caffeine in coffee beans varies from species to species. The coffee Arabica contains 1.2%, Coffee Robusta contains 2.2%, and the

[1] University of Life Sciences Ion Ionescu de la Brad , Iasi

hybrid about 1.72%. (Chakraverty A. et al., 2003) The effects of coffee are as follows: initially, caffeine acts in the brain, on neurotransmitters, having a stimulating effect. The main symptoms are increased alertness, but at high doses, it can cause stomach discomfort and problems such as irritability, anxiety, restlessness, insomnia, rapid heartbeat or tremor. These effects depend on the sensitivity to caffeine and the dose consumed. People tolerate different amounts of coffee / caffeine. A number of genes have even been identified that influence a person's sensitivity to caffeine. These genes are linked to enzymes that break down caffeine in the liver, as well as to receptors in the brain that are affected by caffeine. Some people, if they drink a cup of coffee in the morning, can no longer sleep at night, and others can fall asleep instantly after having just consumed a cup of coffee. It's about coffee tolerance. Most people are somewhere in the middle. Those who drink coffee every day will tolerate coffee much better than those who rarely drink it. Tolerance is influenced by certain general health problems, such as anxiety, panic disorder, arrhythmias, high blood pressure, diabetes, or certain medications. (https://www.health.harvard.edu/blog/the-latest-scoop-on-the-health-benefits-of-coffee-2017092512429). The European Food Safety Authority (EFSA) recommends limiting caffeine intake to a maximum of 400 mg per day for a healthy adult (3-4 coffees) and points out that a moderate dose of caffeine is 200 mg (1-2 coffees) - the dose which generally does not raise safety concerns for healthy adults. People tolerate different amounts of coffee / caffeine. A number of genes have even been identified that influence a person's sensitivity to caffeine. These genes are linked to enzymes that break down caffeine in the liver, as well as to receptors in the brain that are affected by caffeine. Some people, if they drink a cup of coffee in the morning, can no longer sleep at night, and others can fall asleep instantly after having just consumed a cup of coffee. It's about coffee tolerance. Most people are somewhere in the middle. Those who drink coffee every day will tolerate coffee much better than those who rarely drink it. Tolerance is influenced by certain health problems, such as anxiety, panic disorder, arrhythmias, high blood pressure, diabetes or certain medications. Coffee in large quantities can lead to nervousness, insomnia, impaired digestion, increased heart rate, palpitations or trembling of the hands. If the body does not receive the required dose of caffeine, symptoms of caffeine withdrawal occur, people develop caffeine tolerance, so they no longer perceive the same effects given by coffee consumption and need higher doses of caffeine to get rid of fatigue. (www. Coffee consumption - effects and recommendations |Medical advises.ro)

MATERIAL AND METHOD

In the experiment, Arabica and Robusta coffee samples, doses from 2 g to 15.38 g Arabica coffee and samples from 1g to 12.5g Robusta coffee were used as materials. Then, the caffeine alkaloid was extracted using ethanol solution with 70% alcohol, prepared with double-distilled water. The chemical standards of caffeine (C 8 H 10 N 4 O 2) (CGA) -1G, respectively, were used (C0750-5G and C3878). Extraction procedures were performed, both at room temperature and at higher temperatures, using water and / or ethanol as solvent. The most efficient, fast, non-invasive and simple method was obtained by extracting 70% ethanol solution at room temperature. The procedure was applied to both whole and ground coffee beans. For each single-origin coffee, 3 g whole beans or 2 g ground coffee were introduced into 60 ml or 100 ml of 70% ethanol solution at 25 ° C in the dark under magnetic stirring. After 24 hours, the suspension was extracted using a vacuum filtration system with a 0.20 m filter (Sartolab BT 1000 system filter) to remove suspended particles from the solution. After filtration, the sample was dissolved again with an equivalent volume of 70% ethanol solution for an additional 24 hours, to determine by taking the second sample if the caffeine and CGA were completely extracted within the first 24 hours. Arabica coffee extraction solutions were diluted 1: 100; those derived from Robusta coffee were diluted 1: 200 or 1: 400 depending on the spectral intensity. The solutions derived from different samples of Arabica coffees were named A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11. Similarly, samples other than Robusta were named R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11. For the preparation of the standard solution, commercial chemical standards of caffeine and CGA were used and dissolved in 70% ethanol solution previously filtered using a 0.20 μm filter. Specifically, in order to minimize errors in the preparation procedure, both chemical standards were first dissolved in alcoholic solution at 10 mg / ml and then solutions at a specific concentration, between 1, 0-10-10 and 1, 0. -10-10, 2 mg / ml, were prepared by further dilution. The samples were dissolved evenly using a magnetic stirrer for about 30 minutes. Then, UV/Vis absorption spectra were recorded to determine the values of the molar extinction coefficient for caffeine and CGA in 70% ethanol solution, respectively, at 272 and 330 nm, as well as expected when ethanol was used mainly as solvent (8). Concentration values for caffeine and CGA were chosen appropriately to apply the Lambert-Beer law in linear form. Calibration curves for chromatographic determination were obtained by triple HPLC measurements of caffeine mixtures

and CGA solutions. Each calibration curve was obtained by injecting increasing concentrations of the mixed samples (in the same range of UV/Vis measurements). Estimated calibration curves for caffeine and CGA by HPLC measurements. UV/Vis absorption measurements were performed on the Shimadzu UV-2401PC spectrophotometer in the range of 200–600 nm, using halogen and deuterium sources for visible and ultraviolet radiation, respectively. The determination of the molar extinction coefficients of caffeine at 272 nm and CGA at 330 nm was performed by applying the well-known Lambert-Beer law, by linearly adapting the absorbance dependence on the sample concentration. The error associated with the concentration was the standard deviation obtained from triplicate measurements. Using Origin 8 and Excel 2013, a spectrum analysis was performed. The full spectrum from 200 to 600 nm was obtained and the corresponding wavelength was extracted to create chromatographic profiles (272 nm and 326 nm, maximum absorption wavelengths for caffeine and CGA absorbance, respectively). The slope obtained from the linear fit for each calibration curve was used to estimate the concentration in all samples (series A1-A11, R1-R11). The error associated with the concentration value was the standard deviation obtained from triplicate measurements.

RESULTS AND DISCUSSIONS

In the experimental research, 11 samples of Arabica coffee and 11 samples of Robusta coffee were studied. With different doses of the same substance, following in the experimental determination the admissible limit for the caffeine concentration. Thus, the experimental samples had the following increasing concentrations of caffeine from 50 mg/100 g, 75 mg /100 g, 100 mg/100 g, 125 mg/100 g, 175 mg/100 g, 200 mg/100 g.

The level of caffeine in the coffee was determined, correlated with the amount of coffee used to make the coffee. The measured doses were 5 doses, 5 doses and ½, 4 doses and ½, 4 doses, 3 doses and ½, 3 doses, 2 doses and ½, 2 doses, one dose and ½, one dose, ½ dose. (one dose weighs 5 g of ground coffee). The lethal dose is the dose of the chemical that causes the death of 50% of the organisms tested, which is noted LD50 = 200 mg of caffeine / kilo body. Thus, at low doses of coffee there is no toxic effect (No observable adverse effect level) - NOAEL. The level of caffeine in the coffee was determined, correlated with the amount of coffee used to make the coffee. The measured doses were 5 doses, 5 doses and ½, 4 doses and ½, 4 doses, 3 doses and ½, 3 doses, 2 doses and ½, 2 doses, one dose and ½, one dose, ½ dose. (one dose weighs 5 g of ground coffee). The lethal dose is the dose of the chemical that causes the death of 50% of the organisms tested, which is noted LD50 = 200 mg of caffeine / kilo body.

Thus, at low doses of coffee there is no toxic effect (No observable adverse effect level) - NOAEL). When the dose of caffeine increases from 150 mg / kg body weight to 200 mg / kg body weight, a small number of individuals may be affected, representing the most vulnerable group. If the dose is increased from 200 mg / kg body weight to 250 mg / kg body weight, most or all individuals may be affected. Thus, the severity of the body's response increases with increasing caffeine dose (*figure 1*).

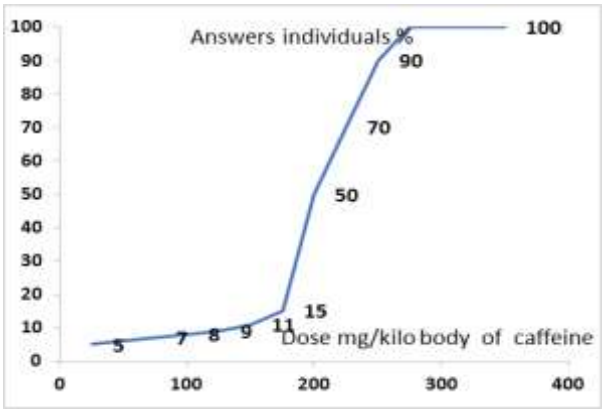

Figure 1 **Dynamics permissible limit dose per kilogram of body caffeine NOAEL**

Regarding the permissible limit of the concentration in caffeine varies increasing and has beneficial effects from 50 mg to 200 mg / kilo body (samples A1, A2, A3, A4, A5, A6, A7) while the caffeine identified in samples A8, A9, A10, A11 with values between 225-300 mg can have side effects, here we can say that we have coffee prepared with 4 doses, 4 doses and ½, 5 doses, 5 doses and ½. (*figure 2*).

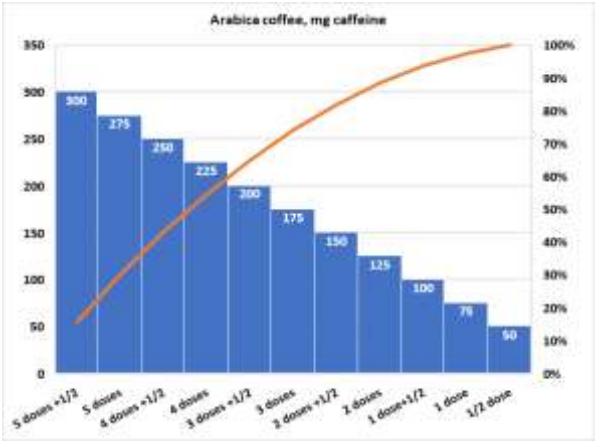

Figure 2 **Dynamics of the permissible limit for the caffeine in Arabica coffee samples**

The permissible limit of caffeine concentration varies increasing and has beneficial effects from 50 mg to 200 mg / kg body weight (samples R1, R2, R3, R4, R5, R6, R7) while caffeine identified in samples R8, R9, R10, R11 with values between 225-300 mg can have side effects, here we can say that we have coffee prepared with 4 doses, 4 doses and ½, 5 doses, 5 doses and ½. (*figure 3*).

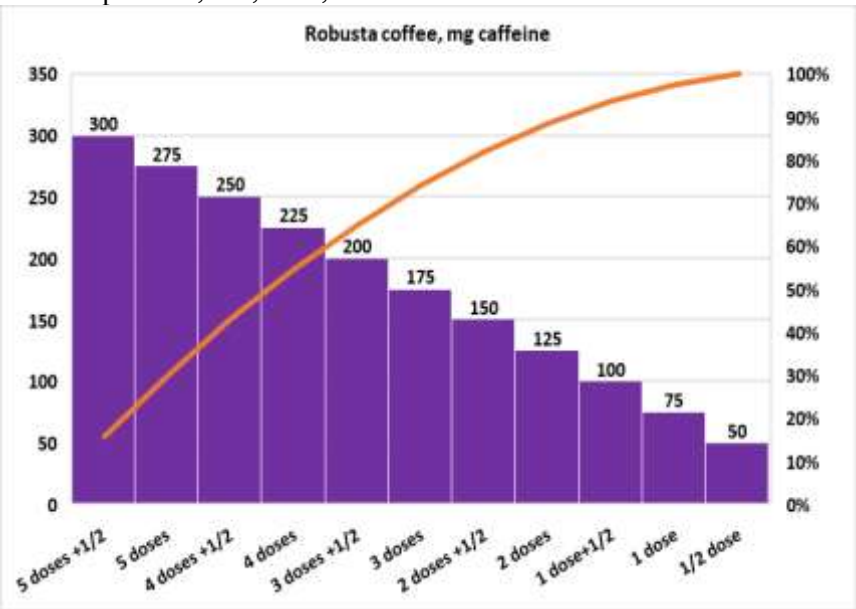

Figure **3 Dynamics of the permissible limit for the caffeine in Robusta coffee samples**

The intake of mineral substances in Arabica coffee samples varies from 100 mg to about 700 mg, directly proportional to the concentration of caffeine and the amount of coffee consumed in an increasing proportion, from 1.92 g of coffee to 15.38 g Arabica coffee, which means a coffee prepared with 3 doses and. The determinations were performed up to the LD50 limit (*figure 4*).

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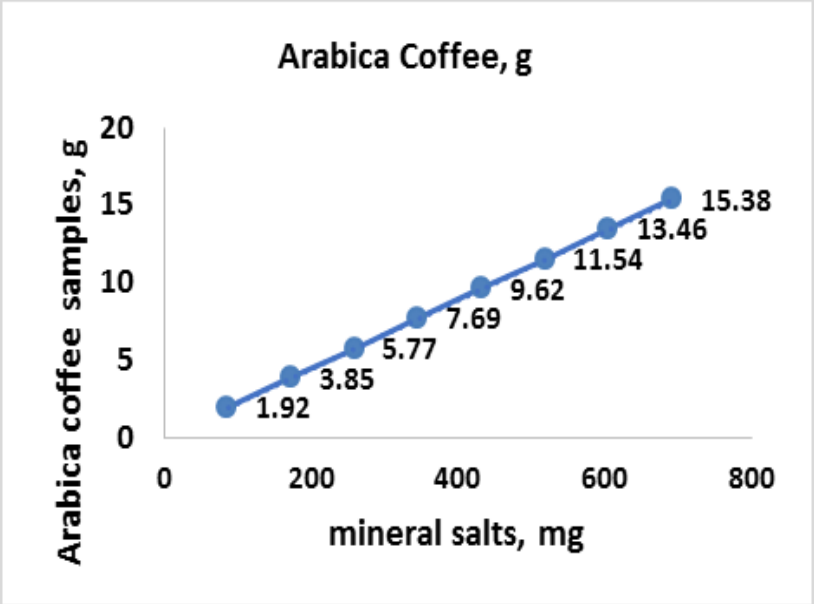

Figure 4 **Mineral salts concentration versus the dose of caffeinein in Arabica coffee samples**

The intake of mineral substances in the samples of Robusta coffee varies from 48.5 mg, directly proportional to the concentration of caffeine, respectively to the amount of coffee consumed in an increasing weight, from 1.042 g of coffee to 12.5 g of Robusta coffee, which means a coffee prepared with 3 doses and the determinations were performed up to the LD50 limit.(*figure 5*).

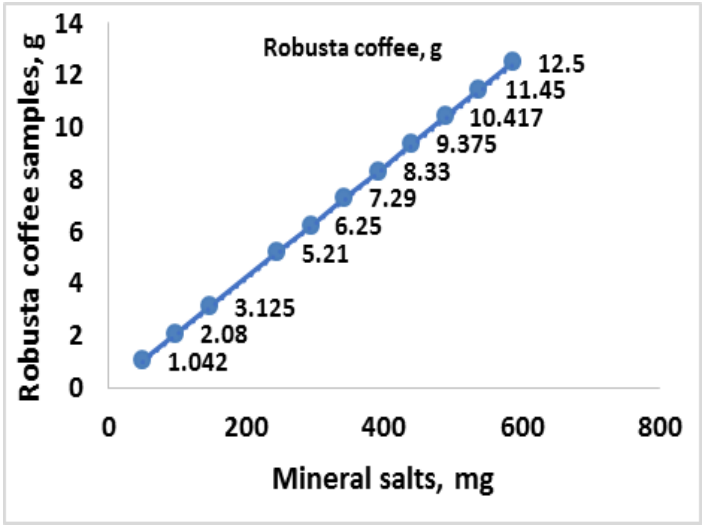

Figure 5 **Mineral salts concentration versus the dose of caffeine in Robusta coffee samples**

In *figure 6* we made the correlation between the concentration in caffeine up to the allowable limit of 200 mg / kilo body and the mineral substances in the samples of Arabica coffee 173.25 mg /1/2 dose at 692.1 mg/3 doses and 1/2 coffee and mineral substances in Robusta coffee samples 48.94 mg/ ½ dose of coffee at 391.51 mg/3 doses and ½ coffee. The daily requirement of mineral salts in optimal nutrition, the recommended daily dose of RDA% is 5 g, ie 5000.5 mg. (Official Journal of the EU Commission Directive 2008/100 / EC of 28 October 2008, Art. 4, Annex I, L 28/5/11). From this it can be concluded that 13.88% of the necessary mineral substances (691.2 mg) can be provided by consuming a coffee from the Arabica sort with the allowable limit of caffeine of 200 mg /kilo body. In the Robusta range, the concentration in mineral substances reaches 7.94% compared to RDA%..

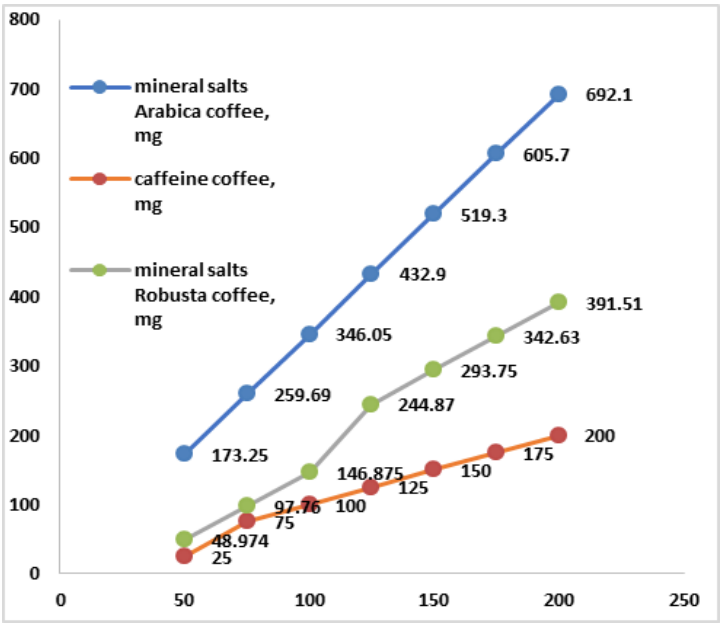

Figure 6 **Correlation between mineral salts, caffeine and doses of Arabica/Robusta coffee**

CONCLUSIONS

1.A moderate dose of caffeine is 200 mg, 1-2 coffees which contains about 100-200 mg of caffeine, a short espresso contains about 50 mg of caffeine and a cappuccino (200 ml) about 70-170 mg of caffeine. However, the effects depend on sensitivity to caffeine and the dose consumed. The benefits of coffee consumption are also recognized by medicine, helping us to increase energy levels, reaction time and cognitive function, reduces the risk of depression and it accelerates metabolism and can help burn lipids by up to 3-11%, can

reduce the risk of type 2 diabetes, Alzheimer's, Parkinson's, has a diuretic and laxative effect. The benefits of coffee / caffeine are attributed to polyphenols - antioxidant nutrients, but the effects are short-term and cannot replace sleep.

2.The caffeine is an alkaloid that is the most commonly used psychoactive substance in the world. Caffeine is absorbed into the bloodstream and reaches the brain, where it blocks an inhibitory neurotransmitter called adenosine. This increases the levels of other neurotransmitters such as norepinephrine and dopamine, which increase the activity of the brain. Caffeine can also increase the level of adrenaline in the blood and can improve human physical performance by 11-12%.

3.Consumption preference is given by the perception of each consumer who appreciates coffee by aroma, concentration in volatile substances and by active principles. Higher concentration in the coffee gives more intensive aroma coffee. The intensity of the coffee assortment is also related to the soluble dry matter content. Some people prefer extractive drinks, others prefer bitter or light coffee.

4. This experimental approach shows that the increased intake of mineral substances in coffee, along with caffeine makes us to consume daily the dose of coffee needed by the body because it needs minerals. From here it can be concluded that 13.88% of the daily requirement of mineral substances (691.2 mg) can be ensured by consuming an Arabica coffee, and in the case of Robusta coffee the concentration in mineral salts reaches 7.94% compared to RDA%. In both cases, the mineral substances replace the consumption of other foods, such as vegetables and fruits, which is not a benefit for the body, but only a daily necessity.

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