

Biological Activity of Fresh-squeezed Lemon Juice

Olga I. Ustinova and Yuri V. Ustinov

Medical Institute "REAVIZ", 227, Chapaevskaya Str., Samara, 443001, Russian Federation

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The issue of alimentary correction of health by natural foods of plant origin, metabolically relevant to the organism, is the most important for maintaining human health. Fresh-squeezed lemon juice an hour after intake dramatically increases the biological activity of all body systems, especially cardiovascular system, as well as the stomach-pancreas-spleen systems, lungs, large intestine, liver, and gall-bladder. In case of the functional weakness of these systems, use of lemon juice is appropriate.

Key words: Alimentary correction of health, lemon juice, biological activity of organs, biological activity of lemon juice.

According to research conducted by the World Health Organization, longevity and quality of human life is conditioned by heredity (20%), environmental conditions (20%), life pattern (50%), and a level of health care (just 10%)¹. A healthy life pattern involves healthy (bringing health) nutrition. The intake of nutrients and minor components of food by the human organism is a factor that largely determines the health of the population. Therefore, the alimentary correction of health by natural foods of plant origin, immunoprotectors, metabolically close to the organism, is essential to maintain human health²⁻⁶. Lemon is one of the most important plant products, used not only to improve the taste of food, but also to correct the human's health condition.

Chemical composition of lemon juice depends on the variety and habitat of the lemon tree. Fruit pulp contains up to 8% of citric acid and up to 0.25% of malic acid⁷, as well as sugars – from 2.06 to 6.0% (glucose over 0.80%, sucrose up to 0.75%, and fructose more than 0.60%), proteins – not more than 0.9%, fat (lemon floral attar) up to 0.1%; pectins – up to 0.5%. Besides, lemon

contains also fibre, glycosides of various structures, etc⁸. The content of vitamins, mineral nutrients and macronutrient elements, as well as recommended daily allowance^{8,9} are presented in Table 1.

The lemon fruits also contain biologically active substances, such as flavonoids, coumarin derivatives, and sesquiterpenes^{7, 8, 10}.

In ancient medicine of the East in X-XI century it was believed that lemon "tans" stomach, strengthens the heart, helps against diseases of the liver and stomach, fever, infectious diseases, sepsis, asthma, and angina. It was used as antidote against insect bites. In folk medicine, lemon juice and lemon fruits were widely used against the diseases of the stomach, liver, gallbladder and biliary tract, kidneys, at joint and muscular pain, as a haemostatic, antipyretic, tonic medications; at various infectious diseases, as well as for the treatment of diabetes and hypertension^{7, 10}.

Contemporary research shows that a rich vitamin and mineral composition give the lemon juice a broad spectrum of useful properties. Citric acid contained in the juice composition is converted during digestion into alkalies, reducing the acidity of the stomach and eliminating the burning sensation. Lemon juice thins the bile, stimulates

* To whom all correspondence should be addressed.

its freer outflow, enhances the action of hepatic enzymes and prevents the formation of gallstones. It is able to break down the urate tophus in serious diseases, such as gout and rheumatism. Potassium, contained in the lemon in large quantities, improves the nutrition of the cells of the brain, heart, and nerve terminals. Calcium helps strengthen bones and tooth enamel. The combination of magnesium and calcium supports the body in the periods of increased nervous and physical stress, helps to maintain feeling of well-being and working capacity. Citric acid is capable of forming soluble complexes with calcium that is used in the treatment of diseases associated with stone formation in the pancreas and kidneys. The pectin contained in lemons, along with other nutrients that improve metabolism and blood circulation, can help to reduce the level of cholesterol in the blood, promotes weight loss and normalization of blood pressure. The availability of vitamin C is very beneficial for blood-vascular system since it strengthens blood vessels, making them less permeable, and has a beneficial effect on the capillaries. Besides, this vitamin strengthens the immune system, is an excellent prevention during seasonal epidemics of influenza and ARVI. The beneficial properties of lemon include also antimicrobial and anti-inflammatory effects^{11,12}.

The aim of this study was identifying the nature of the effect of fresh-squeezed lemon juice on the human body, as well as its effect on change in biological and functional activity of human organs.

Main part. Research materials and methods

To analyze change in biological activity of organs under the effect of the lemon juice we have used the RUNO software and hardware system (thermoalgometry). The diagnostics was based on the reflectory connection between the activity of autonomic centers and skin zones sensitivity. The less the sensitivity threshold of the corresponding acupuncture points of the organ's meridian the higher the biological activity of the respective organ. Professional medical diagnostic system RUNO is included in the State Register of Medicines and Medical Products, certified by the Ministry of Health of the Russian Federation. Today it is the most accurate, complete, and at the same time, simple technology of express-diagnostics allowing identifying the changes in

Table 1. The average content of vitamins, mineral nutrients and macronutrient elements per 100 g of lemon juice

Vitamins	Vitamins													
	Vitamin A	Vitamin B1	Vitamin B2	Vitamin B3	Vitamin B6	Vitamin B9	Vitamin C	Vitamin E						
Content in the lemon	0.0010 mg	0.04 mg	0.02 mg	0.2 mg	0.06 mg	9.0 mg	40.0 mg	0.5 mg						
Daily demand	5000 ME	1.5 mg	1.7 mg	20 mg	2 mg	200 µg	60 mg	20 ME						
Mineral nutrients	Mineral nutrients													
	Iron	Potassium	Calcium	Magnesium	Sodium	Sulphur	Phosphorus	Chlorine	Boron	Manganese	Copper	Molybdenum	Fluorine	Zinc
Content in the lemon	0.6 mg	163.0 mg	40.0 mg	12.0 mg	11.0 mg	10.0 mg	22.0 mg	5.0 mg	175.0 µg	40.0 µg	240.0 µg	1.0 µg	10.0 µg	125.0 µg
Daily demand	10-20 mg	1-2 g	1000 mg	400 mg	4-5 g	500-1000 mg	1000 mg	3400 mg	2-5 mg	2 mg	2 mg	75 µg	2-4 mg	15 mg

Table 2. The number and the average age of healthy men and women in various age groups involved in control measurement

Age group	20-29 years	30-39 years	40-49 years	50-59 years	60-69 years
Number of tested people	40	165	65	169	118
Average age in the age group, years	27.7±0.02	37.0±0.08	43.1±0.03	51.7±0.02	64.0±0.01

the organs' functions activity within 3-5 minutes.

Study was conducted based on the tests of apparently healthy men and women¹³ under the most socially significant ages from 20 through 69 years.

To obtain control measurements, i.e. the average annual biological activity of the organs, measurements of the biological activity of organs of apparently healthy people were performed every 2 weeks during 3 years (since November 2012

through October 2015) in the fasted state from 7.00 a.m. to 8.00 a.m. To identify the average biological activity of the organs, 557 measurements were carried out during this period. The number of measurements and the average age of the tested persons in various age groups are presented in Table 2.

To assess *changes* in biological activity of organs under the effect of 50 ml of used fresh-squeezed lemon juice, 65 persons were tested

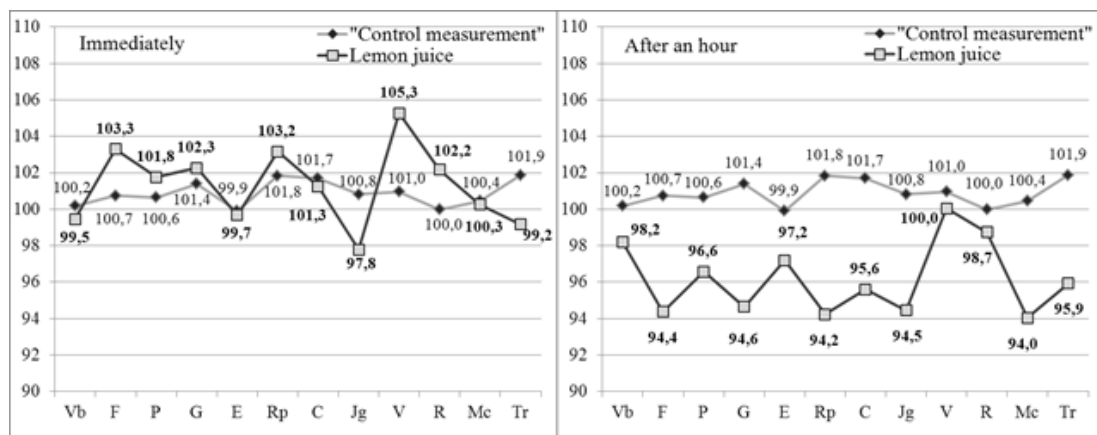


Fig. 1. The indicators of the biological activity status for various organs

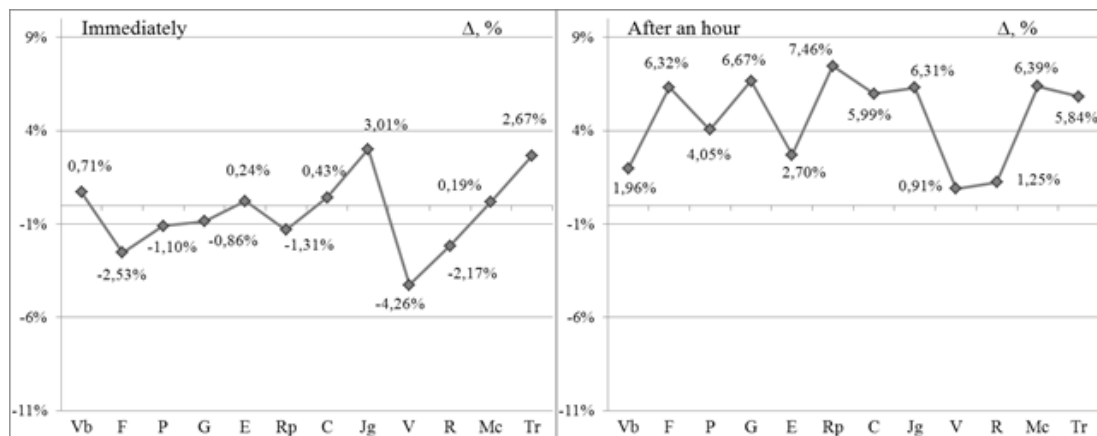


Fig. 2. Changes in the biological activity of the organs in percentage ratio against the biological activity indicators at “control measurements”

Table 3. The average values of biological activity status indicators for various organs

Meridian	Vb Gall bladder	F Liver	P Lungs	G Large intestine	E Stomach	Rp Pancreas – Spleen	C Heart	Jg Small intestine	V Urinary bladder	R Kidneys	Mc Pericardium (vascular system)	Tr Triple heater (hormonal system)
Control measurement	100.17 ±1.49	100.74 ±1.19	100.65 ±1.17	101.40 ±1.22	99.90 ±1.20	101.83 ±1.41	101.69 ±0.95	100.82 ±2.31	100.96 ±2.31	99.99 ±1.39	100.45 ±1.14	101.88 ±0.99
Immediately after the intake	99.5 ±4.23	103.3 ±3.56	101.8 ±3.82	102.3 ±2.60	99.7 ±4.23	103.2 ±5.00	101.3 ±2.34	97.8 ±2.59	105.3 ±7.19	102.2 ±4.81	100.3 ±3.83	99.2 ±2.49
One hour after the intake	98.2 ±4.35	94.4 ±3.71	96.6 ±3.48	94.6 ±3.70	97.2 ±3.33	94.2 ±4.04	95.6 ±3.08	94.5 ±2.57	100.0 ±8.18	98.7 ±4.64	94.0 ±3.29	95.9 ±2.72

Table 4. Changes of the organs' biological activity in absolute values (Δ , points) and percentage ratio (Δ ,%) against the biological activity indicators at "control measurements"

Meridian	Vb	F	P	G	E	Rp	C	Jg	V	R	Mc	Tr
Immediately after the intake	Δ , points 0.71	-2.55	-1.11	-0.87	0.96	-1.33	0.43	3.04	-4.30	-2.17	0.19	2.72
	Δ , % 0.71	-2.53	-1.10	-0.8%	0.95	-1.31	0.43	3.01	-4.26	-2.17	0.19	2.67
One hour after the intake	Δ , points 1.96	6.37	4.08	6.76	3.42	7.60	6.09	6.36	0.92	1.25	6.42	5.95
	Δ , % 1.96	6.32	4.05	6.67	3.40	7.46	5.99	6.31	0.91	1.25	6.39	5.84

immediately after ingesting the juice and *one hour after* ingesting within the same time interval of the day (from 7 a.m.) employing the software and hardware system RUNO.

The analyzed databases were created in Microsoft Excel 2003. The ordered samples were constructed for each of the following indicators:

1. The age of the tested people;
2. 12 measurements of the biological activity of the organs' meridians:

Table 5. Changes in the biological activity of the organs regarding the control measurements *immediately after* intake of fresh-squeezed lemon juice, %

Meridian of the organ	Jg	Tr	E	Vb	C	Mc	G	P	Rp	R	F	V
%	3.0	2.7	1.0	0.7	0.4	0.2	-0.9	-1.1	-1.3	-2.2	-2.5	-4.3

Table 6. Changes in the biological activity of the organs regarding the control measurements *one hour after* intake of fresh-squeezed lemon juice, %

Meridian of the organ	Rp	G	Mc	F	Jg	C	Tr	P	E	Vb	R	V
%	7.5	6.7	6.4	6.3	6.3	6.0	5.8	4.1	3.4	2.0	1.2	0.9

Changes in biological activity of the organs after intake of lemon juice with regard to "control measurement" are presented in absolute values and percentage ratio in Table 4 and Fig. 2.

Final part

Changes in the biological activity of the organs regarding the control measurements *immediately after* intake of fresh-squeezed lemon juice are presented in Table 5. Changes in the biological activity of the organs regarding the control values *one hour after* intake of fresh-squeezed lemon juice are presented in Table 6.

The comparison of the results (Fig. 2, Tables 5 and 6) show that the total changes in the biological activity of all organs *immediately after* intake of fresh-squeezed lemon juice is "-4.3%", i.e. the total biological activity of the organism decreases. Speaking the language of Oriental medicine, lemon juice when ingested initially displays the female principle of Yin [14]. At that the biological activity of Jg, Tr, E, Vb, C, and Mc increases, i.e., the conditions of entire cardiovascular system (Jg, Tr, C, Mc), stomach (E), and liver (Vb) are activated. *An hour after* intake

"Control measurement" of the biological activity of the organs;

Biological activity of each organ *immediately after* intake of fresh-squeezed lemon juice;

Biological activity of each organ *one hour after* intake of fresh-squeezed lemon juice.

The average value indices based on the mode, median and moments, as well as their confidence limits, were revealed. The critical level of significance was taken as $p = 0.05$. The indicators of the biological activity status of the organs are presented in Table 3 and in Fig. 1.

of the lemon juice, the total change in the biological activity of all organs becomes equal to "+56,5%", i.e. the total biological activity of the organism increases dramatically. Speaking the language of Oriental medicine, lemon juice, while absorbed by the body, displays a pronounced male principle of Yang¹⁴.

CONCLUSIONS

In summary, we can draw the following conclusions.

1. The response of the body to fresh-squeezed lemon juice *immediately after intake* consists in the decrease of the total biological activity by 4.3%. At that, the biological activity of the cardiovascular system (Jg, Tr, C, MS), stomach (E), and liver (Vb) increases.
2. *An hour after* intake of the fresh-squeezed lemon juice, the biological activity of all body organs and systems sharply increases (in total by 56.5%). Maximum biological activity is displayed by cardiovascular

- system (Mc, Jg, C, Tr) – upsurge in activity by 24.5%; stomach – pancreas – spleen (RP, E) – by 10.9 %; large intestine – lungs (G, P) – by 10.8%; and liver – gall bladder (F, Vb) – by 8.3%. Renal – bladder system (R, V) activates to a lesser extent – just by 2.1%.
3. Thus, we can recommend the use of fresh-squeezed lemon juice for alimentary correction of health to the people suffering from functional weakness of the cardiovascular system, stomach – pancreas – spleen, large intestine – lungs, and liver – gall bladder system.

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