The facts that the physical-chemical properties of modern tablets distinguish them from natural food lumps

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Abstract. It was found that pharmaceutical companies produce drugs in tablet form, physical or physical-chemical properties that are radically different from those of the properties of natural food lumps, in that adult converts food in our mouth before swallowing. It was shown that the conventional shape, color, size, volume, specific gravity, hardness, osmotic and acid activity of modern tablets impair the physical and physicochemical properties of the liquid contents of the stomach is much stronger than such "building" materials, such as chalk, clay, sand, river pebbles and gravel. The results showed, that the value of the specific hardness, deforming tablets, can distinguish modern tablets from each other by more than 5000 times. Therefore, introduction tablets inside without information of ability injuring their action leads to the fact that soft and "unsalted" tablets almost nothing damage, and too "salty" and solid tablets damage the gums, lips, tongue, teeth and dental structures. To reduce the traumatic action tablets offered standardize osmoticity, corrosion and hardness within the range of safe values for soft and hard tissues of the oral cavity and improve standard introduction of tablets in the mouth.

1. Introduction

The modern tablets are manufactured by compressing powders, as they were a hundred years ago. Therefore, they are hard and resemble natural stones. Typically, these artificially made stones look like white or gray circular shaped disks [1, 2]. Before it was found that physical and chemical properties and aggregate state of modern tablets are very similar to comparable pieces of chalk, clay and/or compressed salt [3,4]. But human stomach is not adapted for stones of any size and shape, including silica sand, crushed stone and river pebbles. Similarly, human stomach is not adapted for medical stones, or tablets. However, a man will not stay healthy after swallowing comparable number of most modern tablets [5, 6, 7].

It is paradoxical, but the fact is that there is evidence that tablet-form medications are as hard as rocks, so when a person chew the tablets, he may break his jaw, prosthesis, tooth, crowns, implants, braces or fillings and injure his gums, tongue and palate [7,8,9]. When swallowing the tablets without chewing, one can damage his esophagus and stomach, and even get ulcers [10, 11].

Shown, that tablets quality standard does not consider their hardness [12, 13]. Therefore, every manufacturer has the right to make tablets of any hardness, moreover, he is entitled not to define it or inform the consumer about it. Worse yet, today, the drugs manufacturers do not control the osmotic and acidic impact of tablets and their local irritant effect on the mucous membranes of the mouth and stomach [6, 10, 14, 15, 16]. Therefore, almost all modern tablets demonstrate high physical-chemical
aggressiveness and therefore have acute local irritant and burning effects. All this contributes to the development of drug-caused iatrogenesis, such as gingivitis, stomatitis, gastritis, gastric ulcers and tooth decay [10].

2. Materials and methods
In the laboratory settings, we studied physical and physical-chemical properties of more than 50 tablets of various medications produced by different pharmaceutical companies worldwide. We analyzed their shape, color, weight, diameter, height, volume, acidity and osmolarity. Conventional methods and equipment for drugs quality control were used for this purpose. Additionally, we measured the tablets hardness by Rockwell hardness test method. We also measured hardness at specific load in Brinnel scale (in HB units) [7].

At the same time, we monitored the dynamics of food and tablets movement inside the body, and analyzed viscosity (hardness), temperature, acidity and osmolarity of gastric contents. The studies were conducted using a plastic model of the stomach. For this purpose, we used a clear, colorless 1000 ml plastic container. To imitate food, we introduced 180 g of oatmeal, and 150 ml of milk and/or water from the tap into the container. After putting food and tablets, we added 150 ml of natural gastric juice with pH 0.8-1.2. All substances were introduced into the vessel at a temperature of +37°C. In a parallel series of experiments in the stomach cavity of the input pieces of chalk, clay, gravel and river pebbles of similar size [6].

3. Results
It is shown that all the tablets, food and water go down to the bottom of artificial gastric reservoir and move inside its cavity because of gravity, as well as river sand, pieces of chalk, clay, gravel and pebbles. We found that corrected specific gravity of all modern tablets is greater than 1 g/cm³ and therefore all the tablets sink in gastric juice, water and milk. We also found that if the container is placed vertically, all the tablets fall in one place, and then lie still in the bottom of the cavity like river pebbles in a glass of water, despite of the liquid being added.

However, unlike the pebbles and crushed stones, tablets have aggressive impact on gastric mucosa, they corrode the stomach wall, and may lead to ulcers. The tablets that are most blamed for causing ulcers in the stomach wall are aspirin and its analogs which are known as "non-steroidal anti-inflammatory agents". Our results indicate that in the medication name present wickedness ...

We were the first to see the truth about physiological form of modern tablets!
With our theoretical, laboratory and clinical research, we were able to get rid of this pharmaceutical delusion!
Today we are sure that manufacturing tablets in a circular disk form is a mistake. This form of tablets is not compatible with the specifics of human digestive system. Disk form of tablets is useful only for manufacturers and sellers. However, we do not have standard even for this form of tablets! Surprisingly, today there is no standard not only for the form of tablets, but also for their sizes. Therefore, different manufacturers produce tablets in different forms and size. Our results show that modern tablets differ in diameter and height by up to 3 times, and by up to 10 times in volume.

We decided to analyze the shape and size of the object, which people usually swallow after thorough chewing of food in their mouth. In science, this object is known as "food bolus". For this purpose, we studied the shapes and sizes of food lumps formed in the oral cavity in adult healthy people when chewing fresh bread. We found that natural bolus has a form of an olive with its largest diameter up to 1 cm, and maximum length of 2 cm [6,10]. This olive is dark, has close to zero hardness and medium elasticity, it is porous and has a specific gravity of less than 1 g/cm³, besides, it lacks osmotic aggressiveness towards contents of the mouth and stomach.

So, it follows that God created man to swallow soft and elastic olives, but not hard disks!
Besides, we found that there is no standard for tablets chewing resistance and disintegration in gastric juice, so they are manufactured with varying chewing resistance and disintegration
characteristics. All this increases the range of nonspecific physical-chemical effects of tablets inside the mouth and stomach.

In particular, our results showed that modern tablets differ in chewing resistance by up to 5000 times !(Figure 1).

These data show that the specific values of the pressure deforming the tablets occupy today range from 0.03 ± 0.0001 N/mm² (Xefocam tablets (Lornoxicam 4 mg, Nycomed) to 160 ± 0.3 N/mm² (Ketorol tablets, Dr. Reddy's, India).

The group, which includes a relatively soft tablets, it was presented Ksefokam, Aceclofenac, Fenigidin, Dexamethasone, Acetylsalicylic acid, No-shpalgin, Elefloks, Mirloks, Analgin, Ofloxacin, Nurofen, Pektusin, Sulfosalazin, Fromilid, Prednisolone, Ampisid, and Ketorol. At the same time the most "soft" tablets (with values of hardness less than 2 N/mm²) were tablets of Acetylsalicylic acid, Analgin, Aertal, Nurofen and No-shpalgin.

In the group with respect to solid tablets includes Sodium diclofenac, Nimesulide, Pektusin, Sulfosalazin, Fromilid, Prednisolone, Ampisid and Ketorol. At the same time the most "hard" pills (with the values of the hardness of more than 70 N/mm²) were tablets of Sodium diclofenac, Nimesulid, Pektusin, Sulfosalazin, Fromilid, Prednisolone, Ampisid and Ketorol.

So today, no one knows the true hardness of each tablet. Therefore, today no one knows what will crumble first while chewing, a tablet or a tooth !

The results of our experiments showed that under the simulated conditions, the mixture of oatmeal porridge, gastric juice, and water had the following physical-chemical characteristics:

- Viscosity - in the range of 200 - 500 centipoise,
- Acidity - in the range of pH 4.5 - 8.0,
- Osmolarity - in the range of 240 - 340 mOsmol / l of water.

Then, we introduced into the mixture 20 small river pebbles in the form of circular disks with the diameter of about 6-20 mm, height of 2-6 mm and volume of 0.1-1.0 cm³, and during one hour after that the physicochemical properties of the contents remained virtually unchanged.

Different results were obtained after we introduced 20 tablets of similar shapes and sizes into a similar mixture of cereal, water and gastric juice. In 30 minutes after putting them in this mixture, the contents had the following physicochemical characteristics:
- Viscosity - 100 - 300 centipoise;
- Acidity - pH 6.0 - 7.1;
- Osmolarity - 240 - 340 mOsmol / l of water.

In 30 minutes after adding 20 tablets to the "empty" plastic container (modelling taking tablets in the fasting state), tablets disintegrated halfway. The container contents appeared as suspension with non-decomposed pieces of tablets and had the following physicochemical properties:
- Viscosity value 0 - 10 centipoise;
- Acidity - pH 2.0 - 3.3;
- Osmolarity - 340 - 600 mOsmol / l of water.

Thus, we found that pharmaceutical definition ranges of mass values, diameter, height, volume, and the specific pressure, deforming tableted drugs, indicates the absence of a uniform standard in modern tablets. In particular, there is currently no acceptable limit values of their hardness. Under these conditions, the pharmaceutical companies are producing tablets with a size and hardness selected at its discretion, by accident or out of ignorance, not quality standard tablets. This has led to the fact that different drugs tablets today are of different sizes, hardness, and strength when chewed. The maximal great range of differences of tablets we found in their hardness (crushing strength tablets). Uncertain tablet hardness impairs their quality.

We believe that it is time to standardize hardness of the tablets and make them within the minimum hardness. To this end, we propose to introduce a new indicator of the quality of drugs - namely, the value of the minimum specific pressure that deforms the tablet. This indicator tablet quality can be determined with the help of the device, which is known in the mechanics of solids, called hardness Tester. The value of this indicator is invited to indicate in Brinell units, which are determined by the Rockwell method. In addition, the tablets should not sink in the gastric juice as stones. The tabletsshouldfloatontheliquidsurface[17].

4. Conclusions
Thus, pharmaceutical companies manufacture tablet-form medications with physical or physical-chemical properties, which are entirely different from those of natural food bolus, which we have in our mouth before swallowing. It was shown that conventional shape, color, size, volume, specific gravity, hardness, osmotic and acidic properties of tablets affect the physical and physical-chemical properties of oral and gastric cavities contents. It is proved that improper physical and physical-chemical characteristics of modern tablets result in reduced medication safety for the digestive system, and increase their non-specific physical and physical-chemical aggressiveness when ingesting.

Therefore, the human digestive system happily accept pills only if their physical and physicochemical properties will not differ corresponding properties of natural food lumps produced in the oral cavity of the quality of food.

References
[1] Nikitiuk D B, Reshetnikov A P and Nasirov M R 2016 Modern problems of science and education 2. URL: http://science-education.ru/ru/article/view?id=24185
[2] Urakov A L, Strelkov N S, Lipanov A M, Dementiev V B and Urakova N A 2007 Chemical
Strelkov N S, Urakov A L, Korovyakov A P, Muraveva O V, Korepanov M V, Urakova N A and Feigin V P 2002 *Morphological newsletter* 3 95

Urakov A L, Strelkov N S, Urakova N A, Mihailova N A, Karlova T B, Kamenschikov Y G and Feigin E P 2008 *Eksperimental'naia i klinicheskaia gastroenterologiya* 2 27 (in Russian)

Urakov A L, Strelkov N S, Lipanov A M, Gavrilova T V, Dementyev V B, Urakova N A and Reshetnikov A P 2007 Newton's Binomial as a "formula" development of medical pharmacology (Izhevsk: Institute of Applied Mechanics Ural branch of the Russian Academy of Sciences) 192 p

Urakov A L, Reshetnikov A P, Kopylov M V, Kasatkin A A and Baimurzin D Y 2016 Pills violate the phisico-chemacal state of the stomach contents, *In L. A. Gömze (Editor) 3rd International Conference on Competitive Materials and Technology Processes* (Miskolc-Lillafüred, Hungary) 40 http://dx.doi.org/10.1088/1757-899X/123/1/012007

Urakov A L and Reshetnikov A P 2014 *Success of Modern Natural Science*, 9 (2) 33

Urakov A L, Urakova N A, Mihailova N A and Reshetnikov A P 2007 *Meditisinskaia pomosch*, 5 49 (in Russian)

Reshetnikov A, Kopylov M, Urakov A and Urakova T 2016 Infrared diagnostics of the calluses disease from braces. *Quantitative Infrared Thermography 2016. ABSTRACTS. 13TH Quantitative Infrared Thermography*. (Gdansk: Gdansk University of Tecnology) pp 79–80

Urakov A L, Urakova N A, Reshetnikov A P, et al 2008 *Med. Almanac* 2 45

Urakov A L, Urakova N A and Kozlova T S 2011 *Bullitin of Ural Academy Medical Sciences* 1 (33) 105

Urakov A L, Urakova N A, Reshetnikov A P, Abolmasov N N, Pozhilova Y V, Novikov V E, Lipanov A M, Zabokritskii N A and Bakurinskih A A 2014 Artificial food bolus and method forinstant assessment of dento-facial health with using artificial food bolus. Invention RU Patent 2533840 C2

Urakov A L 2014 Development of new materials and structures based on managed physico-chemical factors of local interaction. In L.A. Gömze (Editor) 3rd *International Conference on Competitive Materials and Technology Processes, Book of Abstracts* (ISBN 978-963-12-0334-9) 9

Urakov A L 2015 *Epitőanyag - Journal of Silicate Based and Composite Materials* 67(1) 2 http://dx.doi.org/10.14382/epitoanyag-jsbcm.2015.1

Korovyakov A P, Vakhrushhev Ya M, Strelkov N S, Urakov A L, Urakova N A, Urakova T V, Korepanova M V, Muravtseva T M and Feigin V P 2003 *Eksperimental'naya i klinicheskaya gastroenterologiya* 1 30 (in Russian)

Urakov A L and Urakova N A 2006 *Biomedicina* 4 66

Urakova N A, Urakov A L, Muraveva O V, Ovchinnikova E N, Scherbakova N V, Tulenkov A M and Perceva N A 2005 Floating tablet. Invention. RU Patent 2254121 C2