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DEFINITION OF THE WETTING CONTACT ANGLES OF APRICOT GUMS (GUMMY ARMENIACAE) WATER SOLUTIONS COLLECTED FROM THE DIFFERENT REGIONS OF ARMENIA

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Apricot gums 5-15% water solutions having the contact angles in the range $0°<\theta<45°$ are impermissible to be used as stabilizers in drug technology. Meanwhile, apricot gum 20% water solution from Vayots Dzor, having wetting contact angles in the range $45°<\theta<90°$, is characterized as a limited hydrophobic solution with typical diphilic molecules, which may convert the hydrophobic molecules into the hydrophilic, and vice versa, hydrophilic molecules in the hydrophobic, regulating the wettability in different technological processes.

Apricot gum – wetting contact angle

Ծիրանենու կամեղի հետազոտվող նմուշների 5-15% ջրային լուծույթների թրջելիության եզրային անկյունը տեղակայված է $45°<\theta<90°$ միջակայքում, որն անթույլատրելի է դեղաձևերի պատրաստման տեխնոլոգիայում՝ որպես կայունացուցիչ կիրառվող նյութերի համար: Մինչդեռ, Վայոց Ձորի ծիրանենու կամեղի հետազոտվող բոլոր նմուշների 20% ջրային լուծույթների թրջելիության եզրային անկյունը ընկած է $45°<\theta<90°$ միջակայքում, որը բնութագրում է այս լուծույթներին որպես սահմանափակ հիդրոֆոբների՝ բնորոշ դիֆիլային մոլեկուլներով, որոնք կարող են հիդրոֆիլ մոլեկուլները հիդրոֆոբացնել և ընդհակառակը՝ հիդրոֆոբ մոլեկուլները հիդրոֆիլիզացնել՝ այդպես կարգավորելով թրջելիությունը տարբեր տեխնոլոգիական գործընթացներում:

Ծիրանենու կամեղ – թրջելիության եզրային անկյուն

5-15%-ные водные растворы абрикосовой камеди, имеющие краевые углы смачивания в пределах $0°<\theta<45°$, неприменимы как стабилизаторы веществ, в технологии приготовления лекарственных форм. Однако, 20%-ные водные растворы абрикосовой камеди (собранных из Вайоц Дзор), имеющие краевые углы смачивания в пределах $45°<\theta<90°$, характеризуют растворы с амфифильными молекулами как ограниченно-гидрофобные. Из-за способности преобразовывать растворы с гидрофильными связями в гидрофобные, и наоборот, растворы с гидрофобными связями в гидрофильные, можно заключить, что 20%-ным водным растворам абрикосовой камеди свойственна способность нормализации смачиваемости раствора в различных технологических процессах.

Камедь абрикоса – краевой угол смачивания

The world practice shows, that in the biotechnology and drug technology of nutrients different products of natural origin, such us structure formulators, are widely used, which improve the technological properties of raw materials, as well as increase their biological value. Therefore, while choosing nutritional supplements, the preference is given to natural products of carbohydrate origin, because of their affection directly on functional-technical properties due to their structural-mechanical features. [2].

From this point of view herbal exudates (gums) are remarkable, usage of which is expanded due to international scientific attention on their structural-mechanical and rheological properties. Particularly, certain number of scientific researches were registered, which are related to the analysis of structural-mechanical properties of acacia gum water solutions as non-Newtonian liquids [7, 8]. Acacia gum, as a natural polymer, under the name E 414, is used as a best surrogate of gelatin and cellulose in drug technology, particularly in production of soft and solid capsules, ensuring high durability and elasticity [6]. The latter is remarkable not only from the scientific, but also from the technological point of view, because rheological parameters ,such as viscosity, surface tension, wetting play important role not only in all types of drug forms, but also in nutrients.

Particularly, the measurement of wetting degree is extremely important in different spheres of industry (in watercolor dyes, in polyvinyl glues, pharmaceutical and cosmetic industry). The content and physical properties of windscreens, lenses, cowering layers may be changed by measurement of contact angles. From medicinal point of view, to prevent blood clots formulation the wetting contact angle of useful substances is taking into account, which should be larger, in order not to get wet with blood [4].

In drug technology for suspensions preparation as a supplementary material are used substances, which increase viscosity of dispersive environment. The latter stabilizes suspensions preventing sedimentation of dispersive phase. Often surface active agents of synthetic origin, stabilizers, buffering agents are used, which may lead to undesirable effects. According to State Pharmacopea XI in drug technology gelatin of polysaccharide origin, gums, starch, carboxy-methylcellulose etc. are usually offered as stabilizers [1].

In famous professional literature gums water solutions with certain ratio usually are mentioned (arabic gum 1:2, apricot gum 1:5) as emulsifiers and stabilizers without any scientific approval for that choice[3].

From this point of view we highlighted definition of wetting contact angles of gums water solutions, which have different concentrations, for scientific approval of their usage in drug technology and other spheres of industry as emulsifiers and stabilizers.

Materials and methods. As a material for the research served apricot gums (Armenian vulgaris Lam.) cultivated in different regions (Armavir -Tandzut, Vayots Dzor- Chiva, Kotayk-Zovuni) of Armenia, which were stored each year in spring during juice motion period. The natural exudates of gums were collected without artificial resin-snip in order to avoid tree species extinction. Immediately after collection the primary processing of gums (separation from organic and mineral mixtures, washing, drying) was carried out [5].

The wetting contact angle (θ) measured by the honiometer. Measurements were done for different concentrations (5%, 10%, 15%) of gum water solutions collected from Chiva, which is prominent with high viscosity at the temperature 20 ± 0,1° C. Contact angle

measurements were performed compared to the water , wetting contact angle of which is θ (20° C) = 23.70 ± 0.88 [4].

The physicochemical researches were carried out in the Department of Molecular Biophysics of the YSU.

Results and Discussion. According to physics laws when the wetting contact angle is in the range 0° <θ <45°, it means we have hydrophilic dispersion environment, which will increase the phase sedimentation speed.

As the research results show, the application of apricot gums water solutions up to the 15% concentration , technologically will not ensure the stability of liquid drug forms of colloidal composition, because in this case the wetting contact angle indicators are in the range 0 °<θ <45 ° (tab. 1).

Meanwhile, for concentration higher than 15% such as 20 %, the wetting contact angle of apricot gums water solutions exceed the range 45° (θ>45°), which was obvious in Chiva sample, and in Tandzut and Zovuni samples, deviations were in the permissible error areas 45°≤ θ° (tab. 2, 3).

It proves that in this case we are dealing with a highly hydrophobic substances, wetting contact angles of which are in the range 45°<θ <90°.

This means, that 20% water solution of apricot gums , which is equivalent to 1:5 ratio with water, is the starting minimal concentration , which may ensure the necessary index of wetting contact angles for colloidal systems stabilization .

Table 1. The wetting contact angles indexes (t=20°, P≤0,001) of apricot gum (5%, 10%, 15%, 20%) water solutions, stored from Vayots Dzor (Chiva)

The concentration of apricot gum water solution, %	Relative density, (ρ/ρo±m)	Wetting contact angle, (θ °± m)	The range of wetting contact angle, < θ <
5	1.341±0.001	37.7±0.25	0° < θ < 45°
10	1.362±0.001	42.3±0.09	0° < θ < 45°
15	1.375±0.002	44.6±0.24	0° < θ < 45°
20	1.603±0.001	50.6±0.09	45° < θ < 90°

Table 2. The wetting contact angles indexes (t=20°, P≤0,001) of apricot gum (5%, 10%, 15%, 20%) water solutions, stored from Armavir (Tandzut)

The concentration of apricot gum water solution, %	Relative density, (ρ/ρo±m)	Wetting contact angle, (θ °± m)	The range of wetting contact angle, < θ <
5	1.015±0.07	32.14±0.11	0° < θ < 45°
10	1.034±0.0001	36.28±0.09	0° < θ < 45°
15	1.046±0.002	41.4±0.16	0° < θ < 45°
20	1.277±0.0001	45.84±0.1	45° ≤ θ

Table 3. The wetting contact angles indexes (t=20°, P≤0,001) of apricot gum (5%, 10%, 15%, 20%) water solutions, stored from Kotayk (Zovuni)

The concentration of apricot gum water solution, %	Relative density, (ρ/ρo±m)	Wetting contact angle, (θ °± m)	The range of wetting contact angle, < θ <
5	1.002±0.003	28.2±0.07	0° < θ < 45°
10	1.013±0.001	32.18±0.06	0° < θ < 45°
15	1.026±0.001	38.7±0.07	0° < θ < 45°
20	1.253±0.002	45.64±0.07	45° ≤ θ

It is noteworthy, that despite of the statistically precise differences ($p \leq 0{,}001$) of wetting contact angles($\theta°$) of apricot gums 5-20% water solutions , which were collected from different climatic conditions (tab. 1,2,3), only the wetting contact angle for Chiva 20% water solution samples exceed 45°, which is typical for the drops of limited hydrophobic substances. Moreover, the wetting contact angles for the Kotayk and Armavir 20% water solution samples don't differ statistically ($p = 0.14$).

It becomes obvious from the table (tab. 1), that Vayots Dzor samples 5-15% water solutions $\theta°$ – values are higher than of the other two regions ($p \leq 0.001$). It means, that intermolecular attractive forces (cohesion) are more expressed in the first case, than in Kotayk and Armavir samples. It is possible to see the explanation of latter by the analysis of those two samples chemical composition (dominant quantity of ironic acids in Vayots Dzor samples).

However wetting contact angels of all samples 5-15% water solutions are in the hydrophilic range, which is unacceptable in drug technology for substances, which are mentioned to be used as stabilizers. The same is about relative density and viscosity, which according the Stokes formula may change the dispersion phase in suspensions and balance of the dispersion environment.

Thus, when the wetting contact angle is in the range $0° < \theta < 45°$, it means we have hydrophilic dispersion environment, which will increase dispersive phase sedimentation speed. Meanwhile, the same cannot be said about gums 20% water solutions stored from Chiva (Vayots Dzor), wetting contact angles of which are in the range $45° < \theta < 90°$ and describes those solutions as a limited hydrophobic solutions with typical diphilic molecules, which can convert the hydrophilic molecules into the hydrophobic and vice versa the hydrophobic molecules in the hydrophilic, regulating wettability in various technological processes.

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