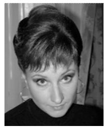
Microencapsulation of retinol-acetate in alginate microspheres



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Introduction

While using the biologicals, as usual, are subjected to great stressful influence by environment factors, that result in decreasing substantially their initial specific activity and changing other applied characteristics. This fact in turn requires the dosage increasing and restoration of drug physicochemical properties, otherwise the application efficiency decreases multiple. Therefore, it is necessary to find the effective decision of such problems as production, storage and introduction of vitamins, flavor additives, biostimulants etc. in food. The process of encapsulation is the most convenient mode of stated above issues decision.

Lipophilic vitamins encapsulation process attracts the great interest. There are well-known technologies, witch allow to encapsulate liposoluble substances (Ribeiro A.J. et al.(1999), Matsumoto S. et al. (1986)). Retinol encapsulation is the promising mode in food supplements technologies (Champagne C. P. et al. (2007)).

This research is targeted to obtain stable emulsion of oil with retinol in sodium alginate solution, to encapsulated retinol in alginate microspheres and to estimate the encapsulated retinol stability under such destructive factors as UV, temperature, heavy metals and air oxygen.

Materials and Methods

Alginic acid Sodium salt from brown algae was obtained from Fluka (loss on drying ≤ 15 %; ash ≤ 30 %; pH (10 mg/ml H_2O) 6.0 – 8.0). All other reagents used were of analytical grade.

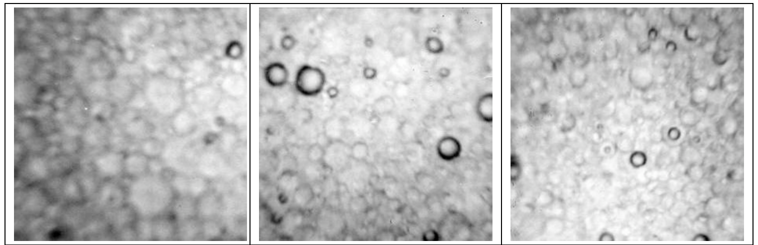
No	Sodium alginate concentration, %	Oil/alginate solution
1	0.5	40/60
2	0.5	30/70
3	0.5	20/80
4	0.75	40/60
5	0.75	30/70
6	0.75	20/80
7	1.0	40/60
8	1.0	30/70
9	1.0	20/80

Table 1

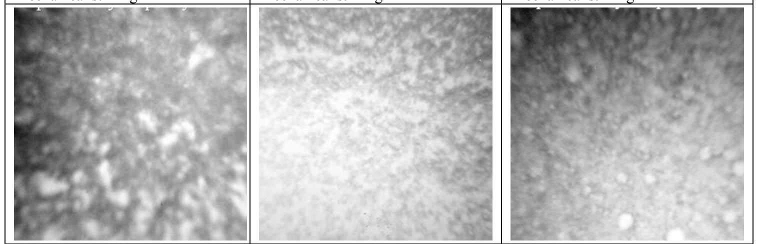
In this work ultrasound generator IKASONIC U50 control was used with US 50-3 Sonotool nozzle which allows treating liquids and solutions of the volume of up to 100 cm³ and ultrasound intensity in the range of 92 up to 460 W/cm^2.

Results and Discussion

To obtain stable emulsion of oil with retinol in sodium alginate aqueous solution the influence of polysaccharide concentration and oil/alginate solution ratio on emulsion lifetime was studied. There were prepared some emulsion samples, their stuff are represented in table 1. The emulsion samples were prepared with the use of ultrasound. The experimental results displayed that such emulsions are the most steady and stable for a long time. The reason of this effect is fine-dispersed emulsions formation (fig, 1).



Oil/alginate solution – 20/80 Sodium alginate concentration – 0.5 % (w/v) Mechanical stirring	Oil/alginate solution – 20/80 Sodium alginate concentration – 0.75 % (w/v) Mechanical stirring	Oil/alginate solution – 20/80 Sodium alginate concentration – 1.0 % (w/v) Mechanical stirring



Oil/alginate solution – 20/80 Sodium alginate concentration – 0.5 % (w/v) Ultrasonic treatment	Oil/alginate solution – 20/80 Sodium alginate concentration – 0.5 % (w/v) Ultrasonic treatment	Oil/alginate solution – 20/80 Sodium alginate concentration – 0.5 % (w/v) Ultrasonic treatment

Figure 1. Comparison of emulsions obtained with the use of mechanical stirring and ultrasonic treatment

During some days the changes occurred with emulsion samples were registered. It can be seen at photos (fig. 2), that in one day in all test tubes except 4 and 7, the well-defined interface appeared. The emulsion one the basis of 1,0 % sodium alginate with the oil/solution ratio 40/60 appeared to be the most stable. Such stuff emulsions were used in further investigations.

The makeup emulsion was added drop by drop with the use of syringe into 3,0 % calcium chloride solution. Generated microspheres were held in solution during 20 – 25 minutes, whereupon were extracted and washed twice by distilled water.

For the purpose of study the stability of encapsulated retinol-acetate the makeup retinol containing microspheres were subjected during 7 days to influence of various destructive factors: heavy metal ions (solutions of lead, cadmium and zinc salts), UV (UV-lamp), enhanced temperature (55 – 60^0 C) and air oxygen. In each case the non-encapsulated retinol-acetate oil solution was used as a control. Retinol amount has been determinate by the reaction with $SbCl_3$ in acetic anhydride presence.

The results of experiments are presented in table 4 and in diagram (Fig. 1): 1 – lead; 2 – cadmium; 3 – zinc; 4 – UV; 5 – temperature; 6 – air oxygen. It was shown that encapsulated in microspheres retinol in all cases was subjected to destructive factor in less. Best of all alginate matrix protect retinol from air oxygen oxidation, as well as zinc, temperature and UV influence.

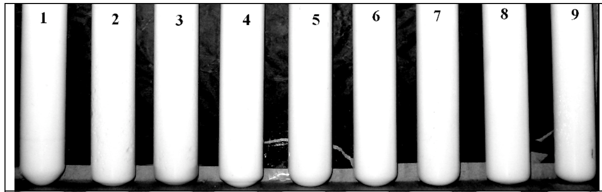
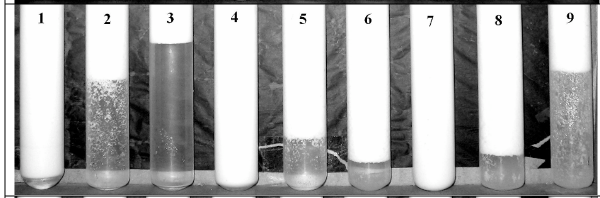
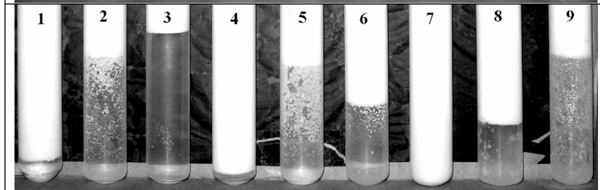
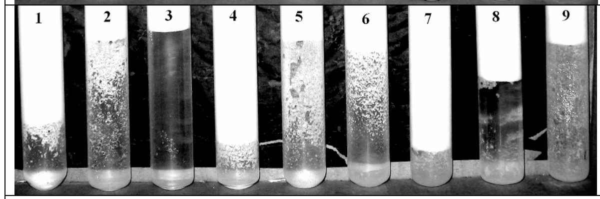
	Makeup emulsion samples
	In one day
	In two days
	In six days

Table 3 The emulsions stability research

Destructive factor	Retinol destruction in microspheres, %	Retinol destruction in control, %
Lead	26,1	34,8
Cadmium	8,7	11,6
Zinc	42,0	63,8
UV	45,0	52,2
Temperature	49,3	58,0
Air oxygen	29,0	74,0

Table 4: Retinol destruction

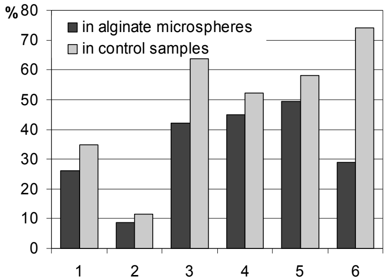


Figure 1: Degree of retinol destruction in microspheres and in control

Conclusions

As a result of experiments carried out it is possible to make following conclusions:

- loss of retinol encapsulated in alginate microspheres was considerably smaller than in control samples. Better it can be seen in example of retinol oxidation by air oxygen;
- encapsulation of retinol and other lipophilic vitamins in alginate microspheres can decrease vitamin loss while product storage, running technological treatment upon retinol-containing products;
- encapsulated retinol form can be used at production of vitaminized food (dairy foods, bread, biologically active additions etc.).

References

- Champagne C. P. et al. (2007) *Microencapsulation for the improved delivery of bioactive compounds into foods.* J. Curr. Opin. Biotechnol. 18 (2) 184 – 190.

- Matsumoto S. et al. (1986) *Production of monodispersed capsules.* J. Microencapsul. 3 (1) 25 – 31.

- Ribeiro A.J. et al.(1999) *Microencapsulation of lipophilic drugs in chitosan-coated alginate microspheres.* Int. J. Pharm. 187 (1) 115 – 123.