APPLICATION OF NEW PROTEIN SOURCES IN FOOD EMULSIONS

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Unicellular freshwater algae *Spirulina* and *Chlorella* reduce inflammation and heart disease and have protective properties against certain types of cancer. A high protein content of *Spirulina* (43.4%) and *Chlorella* (43.7%) was established, which identifies them as suitable emulsifiers in food emulsions. The composition and technology of O / W food emulsions with algae *Spirulina* and *Chlorella* were developed.

The stability and rheological behavior of model emulsions with *Spirulina* и *Chlorela* (4, 8 и 12%) and oil phase vegetable sunflower oil (20, 40 and 60%) with rotary viscometer Fungilab Premium-L (Spain) was studied. A comparison was made with the results of similar systems with skim milk powder. The viscosity was measured at different shear rates (D).

Shear stress (τ), yield stress (θ), plastic viscosity (μ), flow behavior index (n) and flow consistency index (k) were determined.

As the shear rate increases, the structural viscosity, although weak, decreases, which proves the non-Newtonian character of the studied model emulsions.

From the analysis of the rheological characteristics, with sufficient accuracy, we can conclude that emulsions with 20% and 40% oil phase have the behavior of an ideal plastic material. For the description of the rheological curves an equation of the form is suitable: $\tau = \theta + \mu D$.

Emulsions with a higher fat content (60%) and an emulsifying component (8% and 12%), regardless of its type, are pseudoplastic fluids (*Ostvald-de Waele*: $\tau = kD^n$).

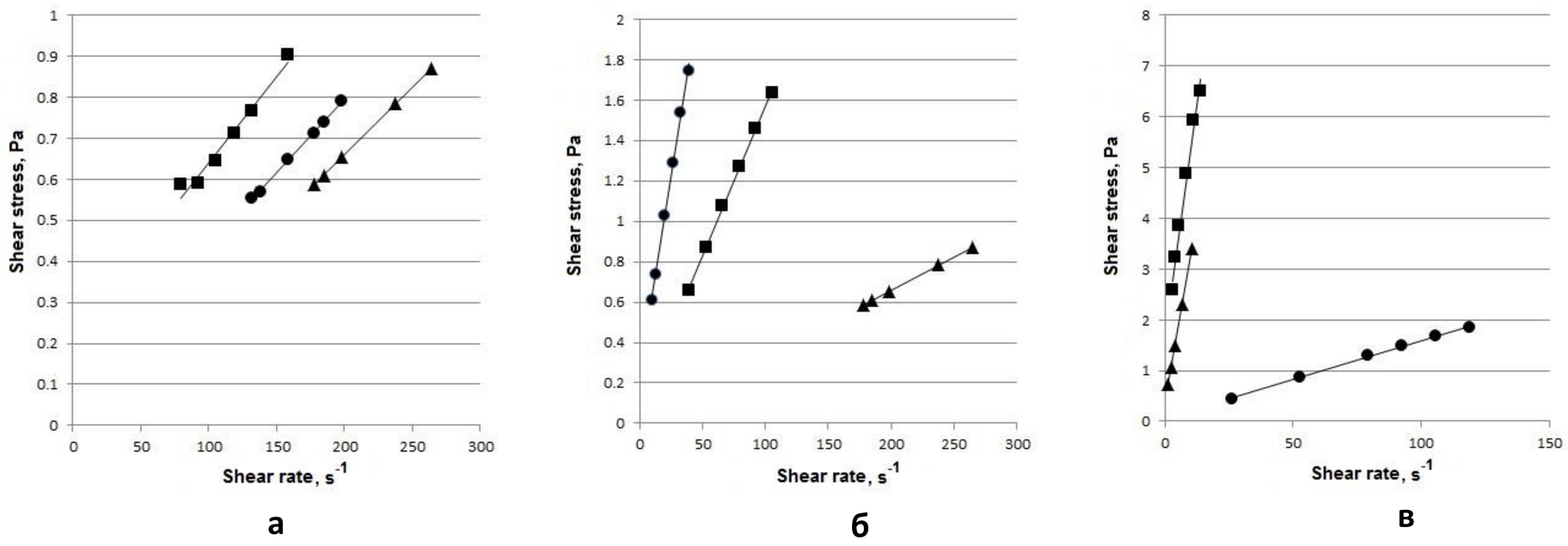

FIG. 1. Rheological curves of emulsions with 4% emulsifying component and 20% (a); 40% (b) и 60% (c) oil phase (-■-) skimmed milk powder; (-▲-) *Spirulina*; (-●-) *Chlorela*

Spirulina emulsions have the highest values for plastic viscosity and consistency coefficient, and those with skimmed milk powder have the lowest values.

Emulsions with 12% *Spirulina* and *Chlorella*, in all three oil phases, have high stability (90%). At the lower of the lower concentration of the mulsifying agent, samples with skimmed milk powder are more stable.

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Table 1. Values of plastic viscosity (μ), yield stress (θ), flow consistency index (k) and flow behavior index (n) of emulsions with 8% emulsifying component

Oil content, %	Skim milk powder			Spirulina			Chlorela		
	μ, Pa.s	θ, Pa	R^2	μ, Pa.s	θ, Pa	R^2	μ, Pa.s	θ, Pa	R^2
20	0.7286	1.2185	0.9947	0.0075	0.1031	0.999	0.0125	0.1973	0.9967
40	0.0129	0.0674	0.9995	0.0781	0.2259	0.9843	0.1599	0.3404	0.9847
	k, Pa.s^n	n	R^2	k, Pa.s^n	n	R^2	$\mu_{пл}$, Pa.s	$\theta_д$, Pa	R^2
60	0.2962	0.7566	0.9979	1.2585	0.5557	0.9114	0.0525	0.0964	0.9580

Table 2. Emulsion stability of emulsions with SMP and OP 20,40 and 60%

	M	B	E	Емулсия, %
4/20	-	3,3	0,2	5,7
8/20	-	3,5	1,5	30
12/20	-	4	1,5	27,27
4/40	-	3	2	55,88
8/40	-	2,5	5	66,66
12/40	-	0	4,5	100
4/60	-	1,5	5	76,92
8/60	-	0	8	100
12/60	2	2,5	2	33

Table 3. Emulsion stability of emulsions with *Spirulina* and OP 20.40 and 60%

	M	У	B	E	% E
4/20	-	0,5	3,5	3,5	46.67
8/20	-	1	3	4	50
12/20	-	0,3	0,2	7	93,33
4/40	-	0,8	3,7	3	40
8/40	-	0,5	4	3,5	75
12/40	-	0	0	6	100
4/60	-	0,5	5	2	26,67
8/60	-	-	6,2	2,3	27,05
12/60	-	-	-	7,5	100

Table 4. Emulsion stability of emulsions with *Chorella* and OP 20.40 and 60%

	M	У	B	E	% E
4/20	1	0,5	3,3	2,2	46.67
8/20	0,5	0,5	2	6	50
12/20	-	0,2	0,3	7	93,33
4/40	-	0,9	3	3,6	40
8/40	-	1	0,5	6,3	75
12/40	-	-	-	7	100
4/60	-	1	3	4	26,67
8/60	-	0,2	3	2,8	35,29
12/60	-	-	-	7,5	100