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EFFECT OF PECTIN CONCENTRATION AND HOMOGENIZATION PRESSURE ON VISCOSITY AND SEDIMENT PERCENTAGE OF A PLAIN YOGHURT DRINK.

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ABCTRACT

Acidic milk was prepared from skim milk powder that reconstituted in water to give 17% MSNF and the resultant milk was heated before culturing with *L. delbrueckii subsp bulgaricus* and *S. salvarius subsp. thermophilus*. Pectin solution that used to stabilize acidic milk drink was prepared by blending pectin with sucrose and dispersed in water to give known concentration. The dispersion was heated in order to sterilize it. The two solutions were mixed in proportions to obtain acid milk drink 8.5% MSNF, then blended and homogenized at known bar, single stage, to produce drink yoghurt. The effect of homogenization pressure and pectin concentration on the physical stability of the product were estimated. Viscosity and % sediment were studied. Pectin concentration 0.35% was the best concentration that gave minimum % sediment and high viscosity. Applying a pressure of 50 bar is enough to obtain the full effect. Higher pressures only give minor improvements.
Keywords: Drinking yoghurt, pectin, homogenizer pressure, % sediment, viscosity.

INTRODUCTION

Yoghurt drink is becoming increasing popular in Egypt not only for its nutritional and healthy effects but also as refreshing drink. Additives such as stabilizer usually added to improve and stabilize viscosity. Pectin is the preferable stabilizer because it has ability to protect milk proteins against precipitation during heat treatment and stabilize milk below their isoelectric point. Addition of the pectin in dry form is more usual. To raise the efficiency of stabilizer, and able to function, it must be separated as individual stabilizer particles in dissolving state, and it must be incorporated at the right stage of the process. The network structure of gel formed by acidification to pH 4.6 is very inhomogeneous, consisting of strands of casein particles (Van Vliet, *et al.* 1989). Homognization is an integral part of the yoghurt manufacturing process. It is carried out chiefly to effect a homogenous dispersion of the milk mix constituents, increase the viscosity, and reduce syneresis (Grigorov, 1966). The object of the present work was to investigate the method of adding stabilizer (pectin) and of acidifying milk , then recognize the minimum pectin concentration to stabilize yoghurt drink. Thus, the second aim was to determine the pressure of homogenization that is enough to disperse pectin solution with acidified milk to obtain the full effect to give the stability of the beverage, being lowest % sediment and higher viscosity

MATERIALS AND METHODS

Effect of pectin concentrations

1. Preparation of pectin solutions.

Genu Pectin type JMJ (Copenhagen Pectin Factory, Denmark was used. Pectin solutions of increasing concentrations (0.0 to 8.0%) were used to obtain final concentrations of (0.0 to 0.4%), which prepared by blending pectin with sucrose (1: 5% wt/wt) to avoid lump formation and dispersed in water. They allowed 30 min for the swelling and heated to 75ºC for 10-15 min with stirring to dissolve the pectin and sterilize the solution before mixing with acidified milk to guarantee the bacteriological quality of the yoghurt drink (Towler, 1984). The pH of pectin solutions were approx. 3.5 to 4.0, (pectinic acids was formed, Garnier *et al.*,1993).

2. Preparation of acidified skim milk (acidifying by lactic acid fermentation).

Medium-heated skim milk powder (SMP) was reconstitute at a concentration 17% MSNF. At least 30 min was allowed for complete hydration. Sample was heated to 85ºC for 30 min and cooled rapidly to inoculation temperature 41ºC. It was inoculated with a 2% yoghurt (symbiotic) culture of *L. delbrueckii subsp. bulgaricus* and *S.salvarius subsp. thermophilus* and incubated at 41ºC for 3 h ,until approximately pH 4.5 was attained (Foley and Mulcahy, 1989), the final gel formed so-called acid casein gel (Heertje, *et al*,1985). The acid gels does not change during the first 24 h after gel formation (Roefs, 1986).

3. Preparation of yogurt drink (stabilization of acidic milk drinks with pectin).

Yoghurt drink was prepared from the acidified skim milk by diluting to 8.5% with sterilized pectin solution. The two solutions were mixed with an efficient stirrer in proportion to obtain the concentration 8.5% MSNF of the final product, here the two flows were mixed 1:1. To allow the pectin to hydrate, the dispersion was kept 30 min before homogenization (Foley and Mulcahy, 1989). A mild homogenization (50 bar at 50ºC), was carried out. Final acidic milk drinks thus contained 8.5% MSNF and 0.0 to .4% (wt/wt) pectin.

Effect of homogenization pressure.

Samples with pectin concentrate that sufficient to stabilize drink yoghurt were exposed to different pressure. 0.0 (sample blending without mechanical treatment), 1.0 (homogenizer used without pressure) then other samples homogenized with pressure that were (50, 100, 150, 200 and 250 bar), single stage. Stability (% sediment) and viscosity in mPa.s were determined.

Product Tests

1. Viscosity ? (mPas)

Samples were subjected to a standard stirring procedure prior to viscosity measurements.A coaxial cylinder viscometer (Bohlin V88, Sweden) was used. Measuring system (C30, infinite sea) was filled with a yoghurt. Viscosity measurement was carried out at 20ºC, and determined at a single shear rate 108 1/s.

2. Sediment percentage:

The stability was measured as the amount of casein particles sediment obtained by centrifugation. Samples (approx.10g) were placed into centrifugal tube and centrifuged for 20 min, at 4500 rpm (approx. 3000 x g). After centrifugation, the supernatant layer was left and the tube was weighed. The weight of sediment was calculated as a percentage of the weight of the sample centrifuged. The amount of sediment is a good indicator of how long the drink can be stored at ambient temperature without appreciable amount of sediment.

RESULTS AND DISCUSSION

Effect of pectin concentration.

The stabilization of an acid suspension of casein particles with pectin is obtained by an interaction between the protein particles (that have positively charged) and the pectin molecules (that have negatively charged). This interaction takes the form of an adsorption of the pectin molecules onto the surface of the protein particles. At low pH the calcium phosphate is dissociated from the micelles and calcium became free (Dalgleish and Law, 1989). These calcium ions in the yoghurt react with the pectin increasing the viscosity. Calcium could be adsorbed on the surface of pectin (Torre.M, *et al.* 1992). The effects of added different concentrations of pectin on viscosity of yogurt drinks are shown in Fig. 1. By increasing the pectin content an initial viscosity increased, and followed by a sudden drop in viscosity to a minimum from where the viscosity slowly increases. Increased viscosity at low pectin concentration is due to decrease the positive charge as the negatively charged stabilizer binds, that will diminish the repulsion between them and increase their tendency to adhere to each other giving rise to the increased viscosity. With increasing pectin concentrations the particles acquire a negative charge, the repulsion between the particles increases, decreasing the adherence between them, which gives rise to the fall in viscosity. Pectin affect the sedimentation by interaction with the milk protein as shown in Fig. 2. At low pH values the pectin molecule will be negatively charged and interaction with the positively charged casein micelles occurs to form a stable complex. This promotes the appropriate charge balance between adjacent micelles, preventing them from agglomerating, thus avoiding sedimentation. With more pectin adsorbed, the repulsion between particles increased sufficiently to make them flow freely in the whey phase and % sediment increased. The sediment / viscosity versus pectin concentration curves determined the minimum pectin

Fig.1- Effect of pectin concentration on % sediment. Sediment versus pectin conc. witout & with homogenization at 50 Kg/cm2.

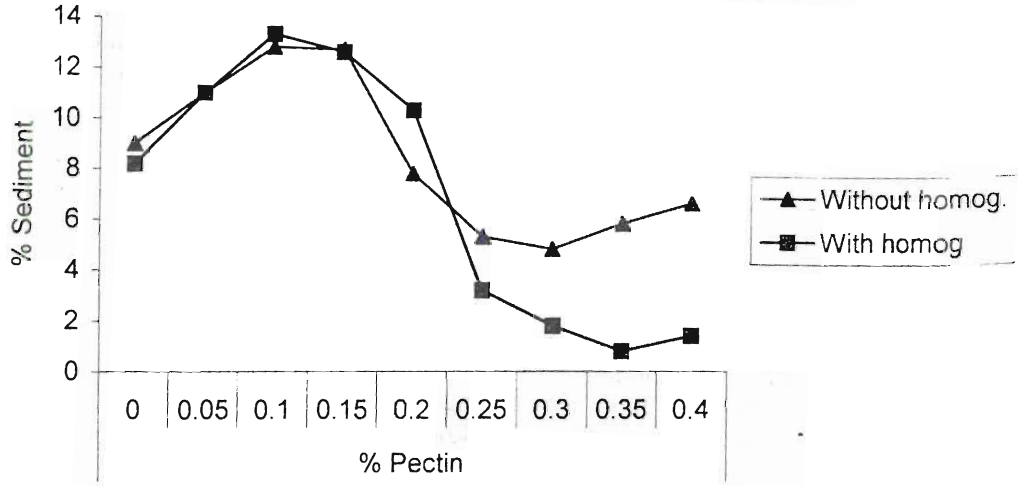


Fig.2- Effect of pectin concentration on viscocity. Viscosity versus pectin conc. without & with homogh. at 50 Kg/cm2

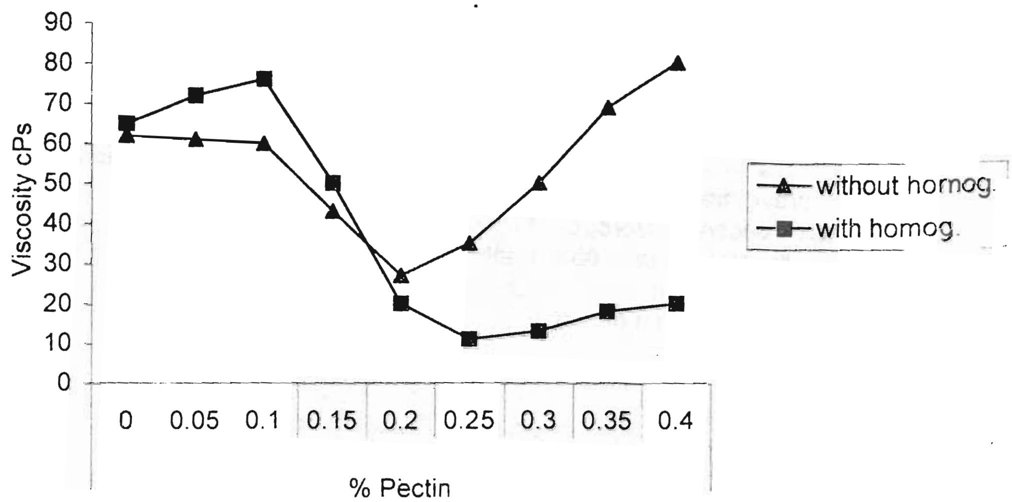
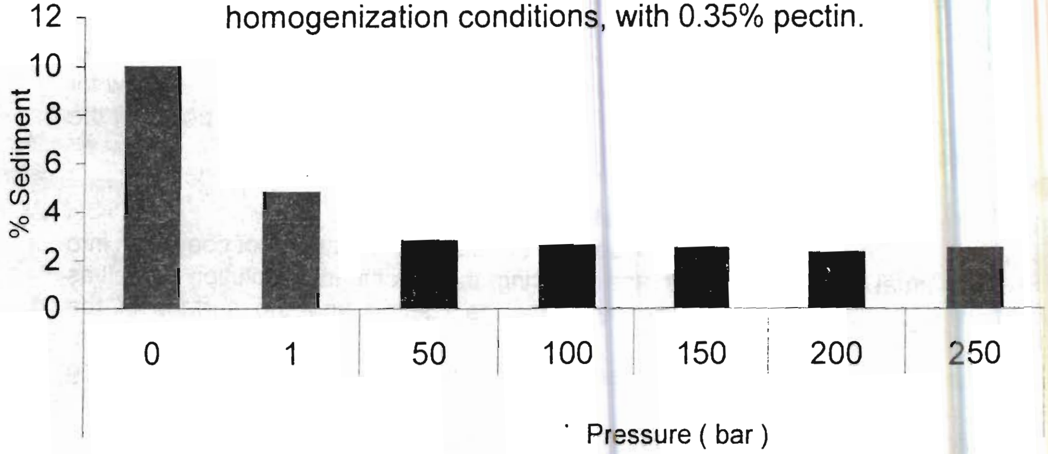
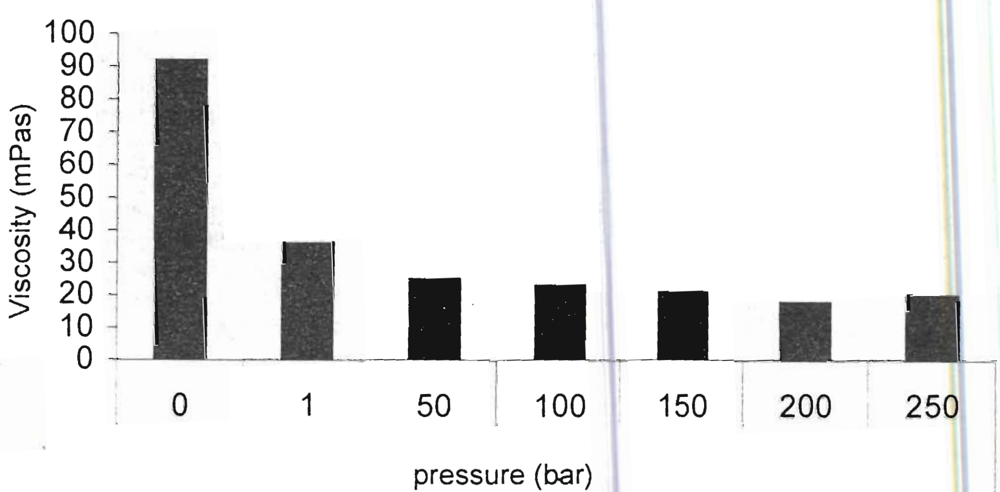


Fig.3- Sedimentation diagram as a function of homogenization conditions, with 0.35% pectin.



.Represents blending without mechanical treatment..
Homogenizer used without pressure. . 1 .

Fig.4-viscosity in mPas diagram as a function of homogenization conditions, with 0.35% pectin.



0. Represents blending without mechanical treatment.
1. Homogenizer used without pressure.

concentration necessary to stabilize a yoghurt drink. It was 0.35% pectin. In practice, the minimum pectin concentration necessary to stabilize a yoghurt drink depends on the actual pectin type used and on casein particle size of the drinks. So, a safety margin should be added is approx. 0.05%, to allow for variation in casein particle size and fluctuation in the stabilizing power of the pectin.

Effect of homogenization pressure.

The homogenization serves to disintegrate lumps of coagulum into individual casein particles and to bring the pectin into solution as well as ensuring optimum contact between the pectin and the surface of the individual casein particles. Results in Fig. 3 and 4 show that, non-homogeneity in dispersion leads to partial lack of stabilization, with founding some agglomeration, so both values (% sediment and viscosity) were high. Sample homogenized without pressure had decreased in both values. Values were decreased after homogenization, because lumps of coagulum were broken up and pectin molecules were adsorbed onto the casein micelles to stabilized them, so % sediment decreased. With increasing the pressure, % sediment and viscosity also decreased as a result of increasing the pressure, reducing the size of the particles, increases their number decreases the distance between the particles, establishing an equilibrium between the tendency to sediment and the repulsion. The particles are evenly distributed in the total volume of the drink. Higher pressures only give minor improvement. A mild homogenization (50 bar) after mixing yoghurt and pectin solution disperses efficiently the pectin and guarantees the full stabilizing effect of the pectin

CONCLUSION

Pectin was used to modify the physical properties of yoghurt drink, viscosity and sedimentation. The change in viscosity as a function of stabilizer concentration is probably due to a change in the adhesion between the particles. Pectin concentration 0.35% was the best concentration that established an equilibrium between the tendency to sediment and the repulsion. A mild homogenization (a pressure of 50 bar) after mixing acidified milk and pectin solution (0.35% pectin), was efficient to stabilize casein particles with minimum % sediment and high viscosity. These parameters could be successfully taken in consideration for the quality control of the product.

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تأثير تركيز مثبت البكتين ودرجة ضغط التجنيس على اللزوجة ونسبة الترسيب فى الزبادى السائل

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تم اضافة مثبت البكتين وهو على الصورة السائلة بدرجات تركيز متفاوتة من (صفر الى ٨و %) الى اللبن المحمض (الزبادى) مجموع الجوامد اللادهنية فيه ١٧% . وتم الخلط ليعطى ناتج نهائى درجات تركيز البكتين بها (صفر - ٤و %) والجوامد اللادهنية بهم ٨,٥ % . وتم تقدير درجة اللزوجة والنسبة المئوية للترسيب فى الناتج النهائى . وأوضحت النتائج أن أفضل درجة تركيز للبكتين والتى أعطت أعلى لزوجة مع أقل نسبة ترسيب كانت ٣٥ ,% ثم استخدمت هذه النسبة فى دراسة تأثير ضغط التجنيس على المخلوط الناتج من خلط محلول المثبت مع اللبن المحمض وذلك على مرحلة واحدة – شملت المعاملات : معاملة بدون أية معاملة ميكانيكية والثانية باستخدام المجنس بدون ضغط تلى ذلك معاملات باستخدام درجات ضغط مختلفة (٥٠ الى ٢٥٠ بار) أوضحت النتائج أن أفضل درجة ضغط تجنيس كانت ٥٠ بار لانتاج لبن زبادى سائل ٨,٥ % بأفضل لزوجة وأقل نسبة ترسيب .