Studies on Stability of Rapeseed Wet Gum as a Source of Pharmaceutical Lecithin

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ABSTRACT: Lecithin wet gum with high water content is less stable during storage than dry lecithin. Deoiling and dehydrating the fresh gum can result in a purified lecithin of high quality. The stability of rapeseed wet gum obtained from double-zero rapeseed varieties was determined at various temperatures. The effect of storage time on volatile substances, acetone insolubles, neutral lipids and acid, iodine, and peroxide values were investigated. The rapeseed wet gum stored a little above 20°C is stable for up to ten days, although in the frozen state (–20°C) no changes in general composition, acid, iodine, and peroxide values were observed during 24 mon of storage.
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KEY WORDS: Lecithin wet gum, rapeseed lecithin, rapeseed wet gum storage, stability of rapeseed wet gum.

In recent years, most of the Central and North European rapeseed crop has been sown with double-zero rapeseed varieties (1–3), providing an opportunity to increase their applications in many products, especially in the pharmacy and food industries.

Previous studies have shown (4,5) that high-quality purified rapeseed lecithin can be prepared directly from the lecithin wet gum obtained from double-zero rapeseed varieties. Deoiled rapeseed lecithin and the product of its fractionation with alcohols (6), obtained from the wet gum, have better chemical and physical properties (4,5) than those prepared from raw lecithin (4,7,8). This is clearly seen in terms of acetone insolubles, phosphatidylcholine (PC) content, and acid value. The lecithin purified in this manner has significantly less color impurities than that prepared from the raw lecithin that is formed by thermal dehydration of the wet gum. On the other hand, lecithin wet gum with high water content is less stable during storage than dry lecithin, but deoiling and dehydrating the fresh gum can result in a purified lecithin of high quality.

The aim of this study was to determine the stability of rapeseed wet gum at various temperatures.

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MATERIALS AND METHODS

The rapeseed wet gum and the raw rapeseed lecithin from double-zero varieties were supplied by Nadodrzańskie Zakkady Przemysłu Tłuszczowego (Brzeg, Poland). The acetone insolubles were determined according to the American Oil Chemists' Society Method Ja 4-4b (9). Phospholipids content was evaluated by a modified Wagner's method (10). Remaining parameters of the rapeseed wet gum and the raw lecithin were measured and calculated as described previously (4). Before measurement, the samples of rapeseed wet gum were dried under vacuum (20°C, 5–10 mm Hg) to constant weight.

RESULTS AND DISCUSSION

The major components of rapeseed wet gum and raw lecithin, including volatile substances, acetone insolubles, and neutral lipids, were considered in this study. The effects of storage time and temperature on essential components are presented in Figure 1.

The volatile substances, mainly water (Fig. 1A), acetone insolubles (Fig. 1B), and neutral lipids content (Fig. 1C), are rather constant at temperatures below 20°C during 30 d of storage. However, a higher temperature (40°C) caused a significant increase in volatile substances, which resulted in foam formation in the wet gum (Fig. 1A). This is connected with a fermentation process of the raw material. For that reason, a significant decrease in acetone insolubles (Fig. 1B) and neutral lipids (Fig. 1C) was also observed after 20 d of storage.

During experiments carried out for 24 mon at –20 and 0°C (frozen state), no changes were observed in volatile substances, acetone insolubles, and neutral lipids content in rapeseed wet gum or in raw rapeseed lecithin (Table 1). Both lecithin materials, stored at these temperatures, are stable and can be used as raw materials for purification for up to 24 mon.

The effect of storage time on the phospholipid components PC, phosphatidylethanolamine (PE), and phosphatidylinositol (PI) in rapeseed wet gum was examined at various temperatures between –20 and 40°C (Fig. 2). There were significant decreases of PC, PE, and PI. The initial values decreased by about 67, 69, and 50%, respectively. It should be empha-

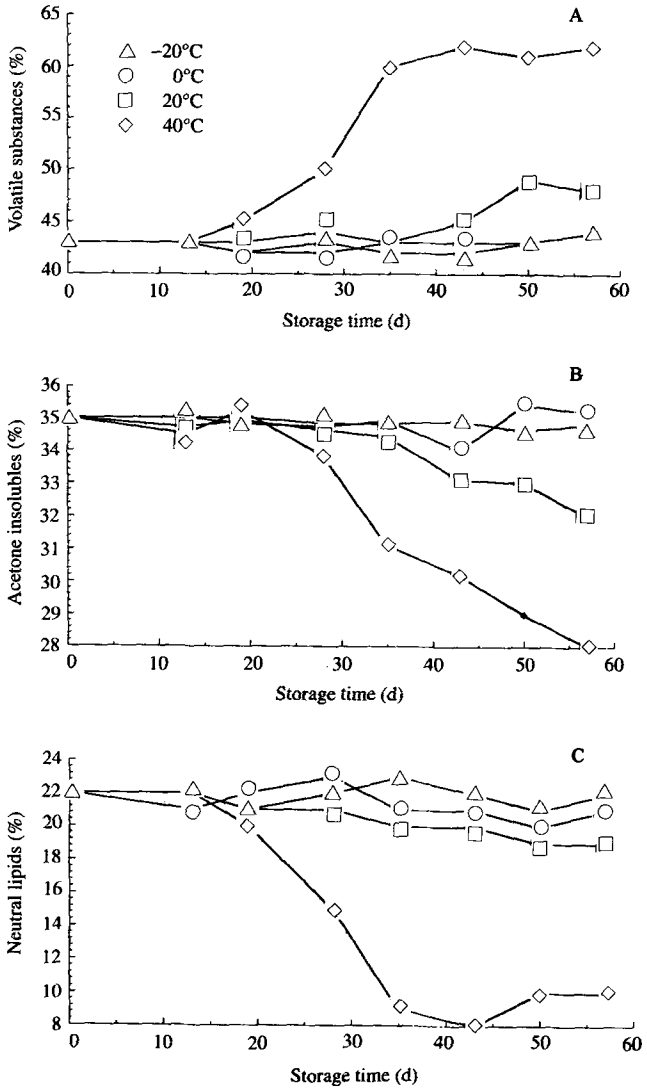

FIG. 1. Effect of storage time of rapeseed wet gum on volatile substances (A), acetone insolubles (B), and neutral lipids (C) contents at various temperatures.

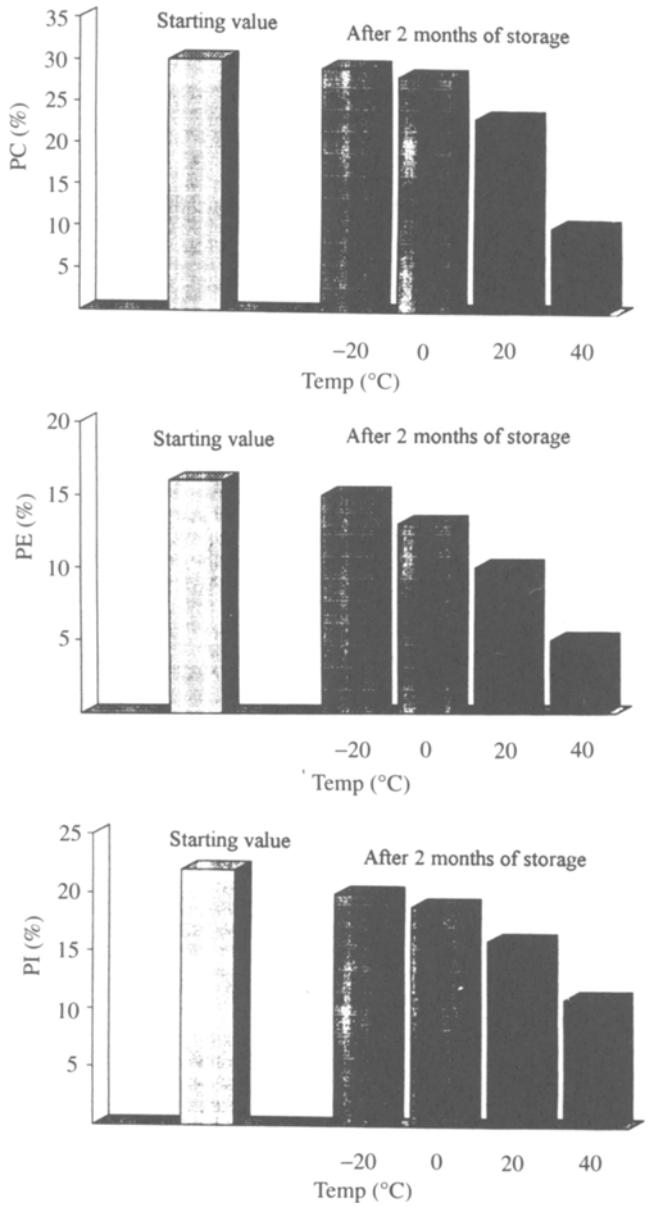

FIG. 2. Phosphatidylcholine (PC), phosphatidylethanolamine (PE), and phosphatidylinositol (PI) contents in dry matter of rapeseed wet gum stored at various temperatures.

sized that the decomposition intensity is different for each phospholipid class. The least change was observed for PI.

The initial parameters, including acid value, pH value, iodine value, and peroxide value, of rapeseed wet gum are given in Table 1. Changes in these parameters during two months of storage are presented in Figures 3 and 4.

A small increase of acid value was observed at low temperatures (−20 and 0°C), whereas at higher temperatures (20 and 40°C), the acid value increased significantly, from 30 to 41–48 mg KOH/g (Fig. 3A). This corresponds to the decrease in the wet gum pH value (Fig. 3B) from 7.0 to 5.0–5.5 after 57 d of storage. However, the acid value of the wet gum stored for 24 mon in the frozen state (−20°C) increased only from 30 to 32 mg KOH/g, and the pH value decreased slightly from 7.0 to 6.9 (Table 1). The acidity increase of rapeseed wet gum, observed during storage, is caused by decomposition products that include phosphatidic acids and fatty acids.

As a result of the autoxidation process during storage of rapeseed wet gum at a temperature of 20–40°C, there was a significant decrease in iodine value (Fig. 4A) and an increase in peroxide level (Fig. 4B). The 24-mon storage of wet gum at low temperatures (e.g., −20°C) caused only minor changes in iodine and peroxide values (Table 1). A strong connection between lowering iodine values and increasing peroxide values was observed. Some of the unsaturated bonds in oleic, linoleic, and linolenic acids are oxidized, and iodine values during wet gum storage are decreased. Simultaneously, the peroxide concentration increased considerably up to 35 d. Between days 35 and 50, a dip in peroxide value was observed for the 20 and 40°C samples. The cause of these changes is

TABLE 1
Effect of Storage Time on General Composition and Parameters of Rapeseed Wet Gum (WG) in Comparison with Raw Rapeseed Lecithin (R) at Various Temperatures[a]

Storage time (mon)	Temperature (°C)	Volatile substances (%)		Acetone insolubles (%)		Neutral lipids (%)		Acid value (mg KOH/g)		Iodine value (g I_2/100 g)		Peroxide value (mmol O_2/kg)		pH Value (1% water dispersion)	
		WG	R	WG	R	WG	R	WG	R	WG	R	WG	R	WG	R
0	—	43	2	35	63	22	35	29	24	76	78	1	1	7.0	6.2
12	−20	42	1	34	64	24	35	30	27	73	76	2	1	7.0	6.2
	0	42	2	35	62	23	34	33	28	67	75	5	2	6.5	6.4
	20	—	3	—	63	—	35	—	29	—	75	—	3	—	6.3
24	−20	45	2	33	63	22	34	31	28	70	77	3	2	6.9	6.4
	0	47	2	32	63	21	35	42	29	63	76	8	2	5.2	6.2
	20	—	4	—	62	—	34	—	28	—	75	—	4	—	6.2

[a]Means of ten measurements.

probably connected with some multiple processes, such as peroxide formation and peroxide decomposition. The peroxide concentration undoubtedly depends on the ratio of the reaction rates. Also, the peroxide level of rapeseed wet gum is connected with temperature and storage time.

Our data show that storage conditions have a significant effect on rapeseed wet gum stability. Due to the high content of water (42–47%), this lecithin material can easily decompose by hydrolysis, autoxidation, and fermentation of polar and nonpolar lipids. When rapeseed wet gum is stored at temperatures slightly above 20°C, it is stable for only up to ten days. However, in the frozen state (−20°C), no changes in general composition and in acid, iodine, and peroxide values of wet gum were observed during 24 mon of storage.

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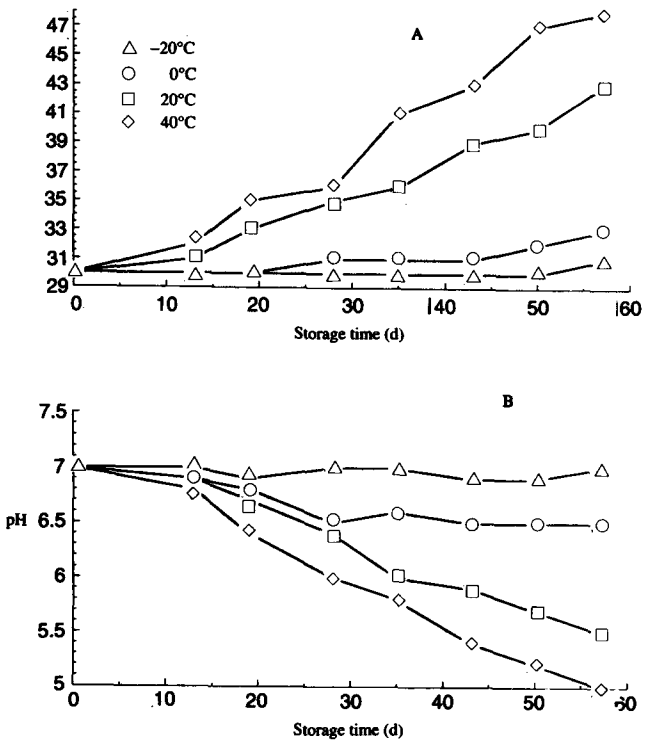

FIG. 3. Effect of storage time of rapeseed wet gum on acid value (A) and pH value of 1% lecithin–water dispersion (B) at various temperatures.

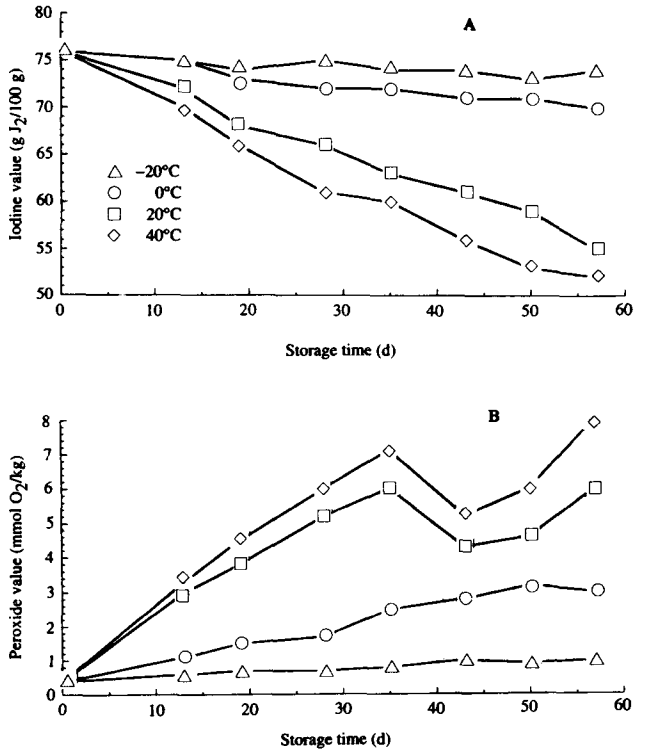

FIG. 4. Effect of storage time of rapeseed wet gum on iodine value (A) and peroxide value (B) at various temperatures.

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