

Effect of refining on the fatty acid, sterol and tocopherols compositions of soybean oil from GM seeds

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Introduction:

- ✓ Soybeans are an exceptional source of polyunsaturated fats, high quality proteins and high levels of vitamin E, this seed makes part of the human diet mainly as vegetable oil and as an excellent source of protein.
- ✓ Nowadays, soybean oil represents almost 30% of the world's vegetable oil production. As most vegetable oils, crude soybean oil must be refined in order to remove unacceptable materials, such as phospholipids, free fatty acids and pigments, that cause a decrease in the product quality.
- ✓ Nevertheless, during this process, desirable components such as phytosterols, tocopherols and polyphenols can be lost.
- ✓ The aim of this work was to determine the compositional changes during extraction and refining processes of soybean oil. Considering that soybean is the most important genetically modified (GM) crop, corresponding to 57% of the world's total biotechnological planted area¹, the studied samples were obtained from GM seeds.

Methodology:

- ✓ Sampling was performed along the extraction and refining steps, from soybean grains to deodorized oil. Samples comprised the pre-extraction steps (cracking, lamination and extrusion-expelling), the extracted crude oil, and the 4 oil refining steps (degumming/neutralization, washing, bleaching and deodorization) (Figura 1).
- ✓ Fatty acid and phytosterols compositions were evaluated by GC/FID and vitamin E profile was determined by HPLC/DAD/FL.

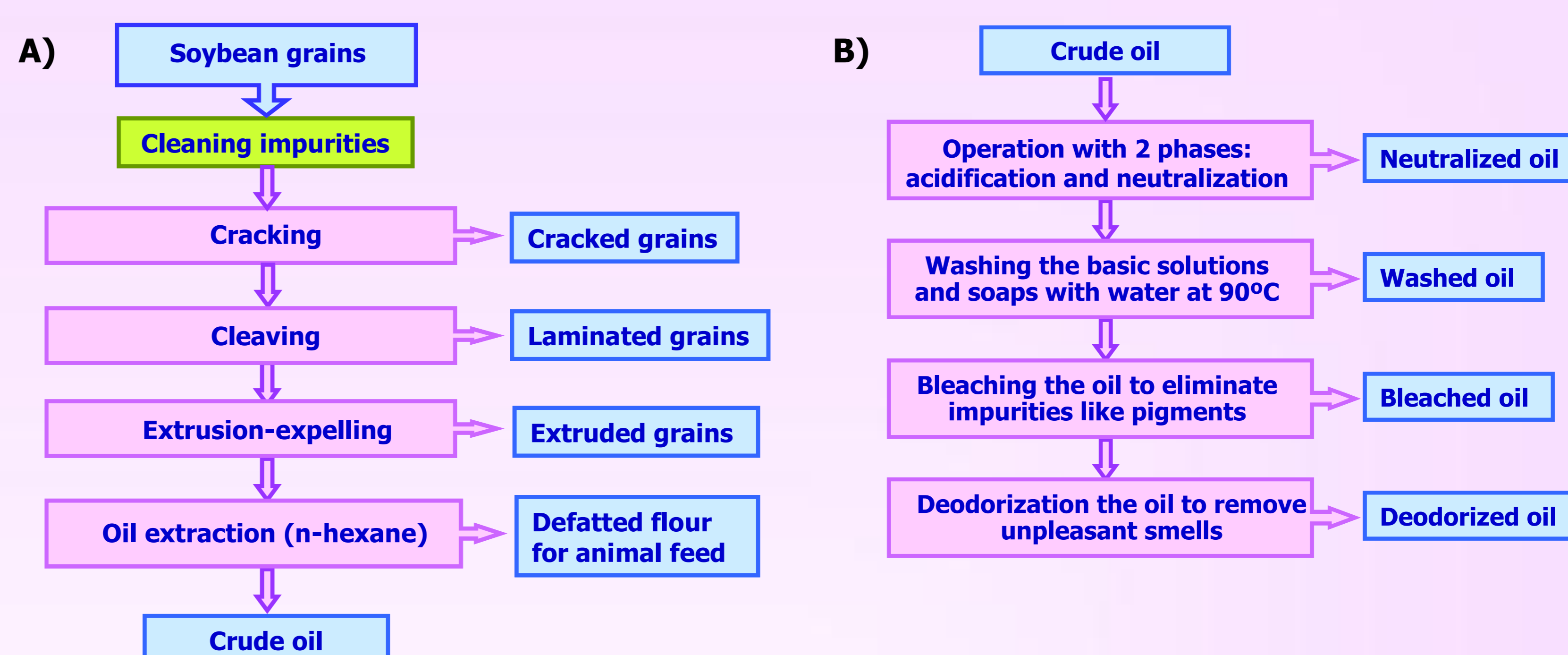


Figure 1 – Different steps that occur during extraction (A) and refining (B) phases.

Results:

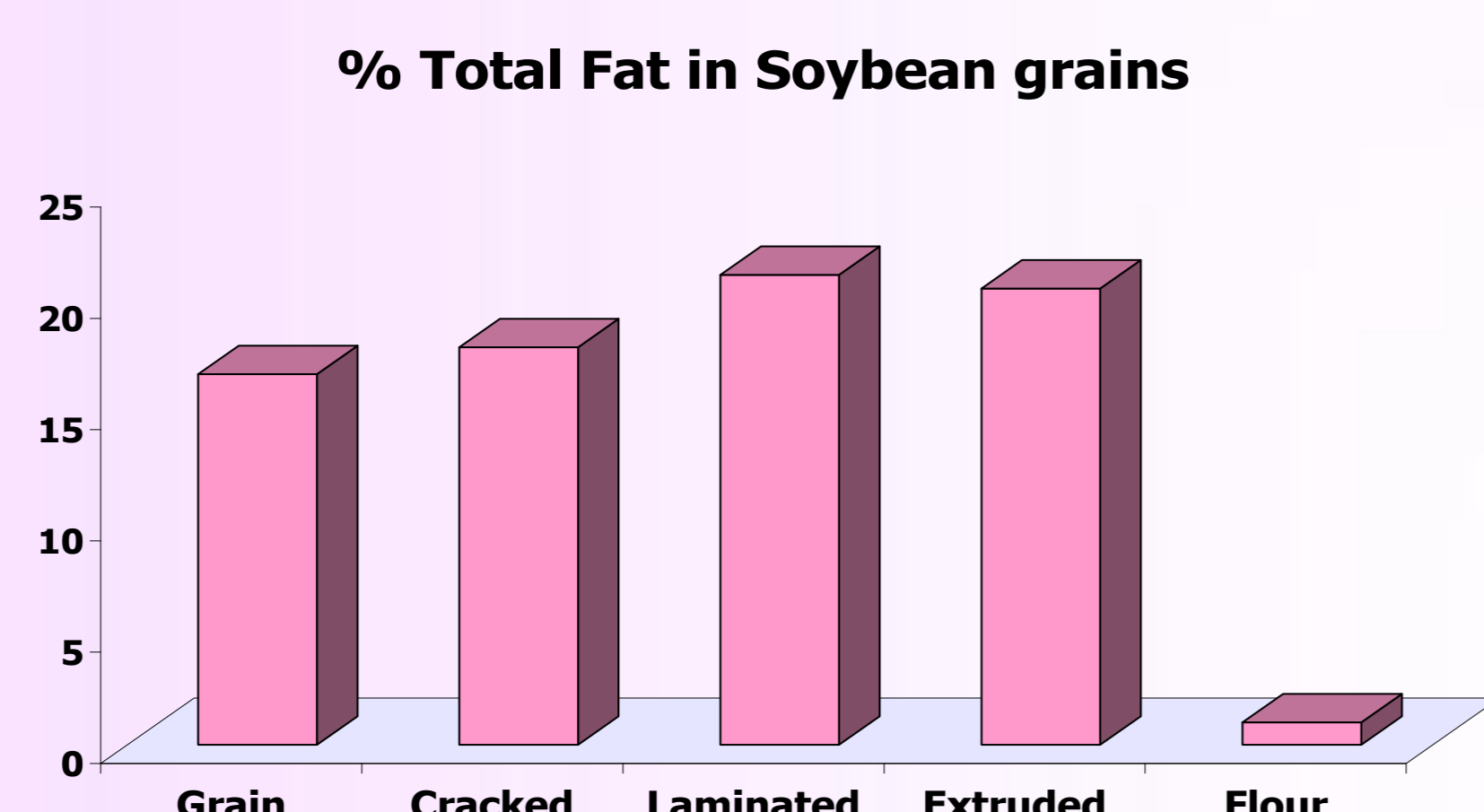


Figure 2 – Fat content (on a dry weight basis) along pre-extraction steps and after oil extraction.

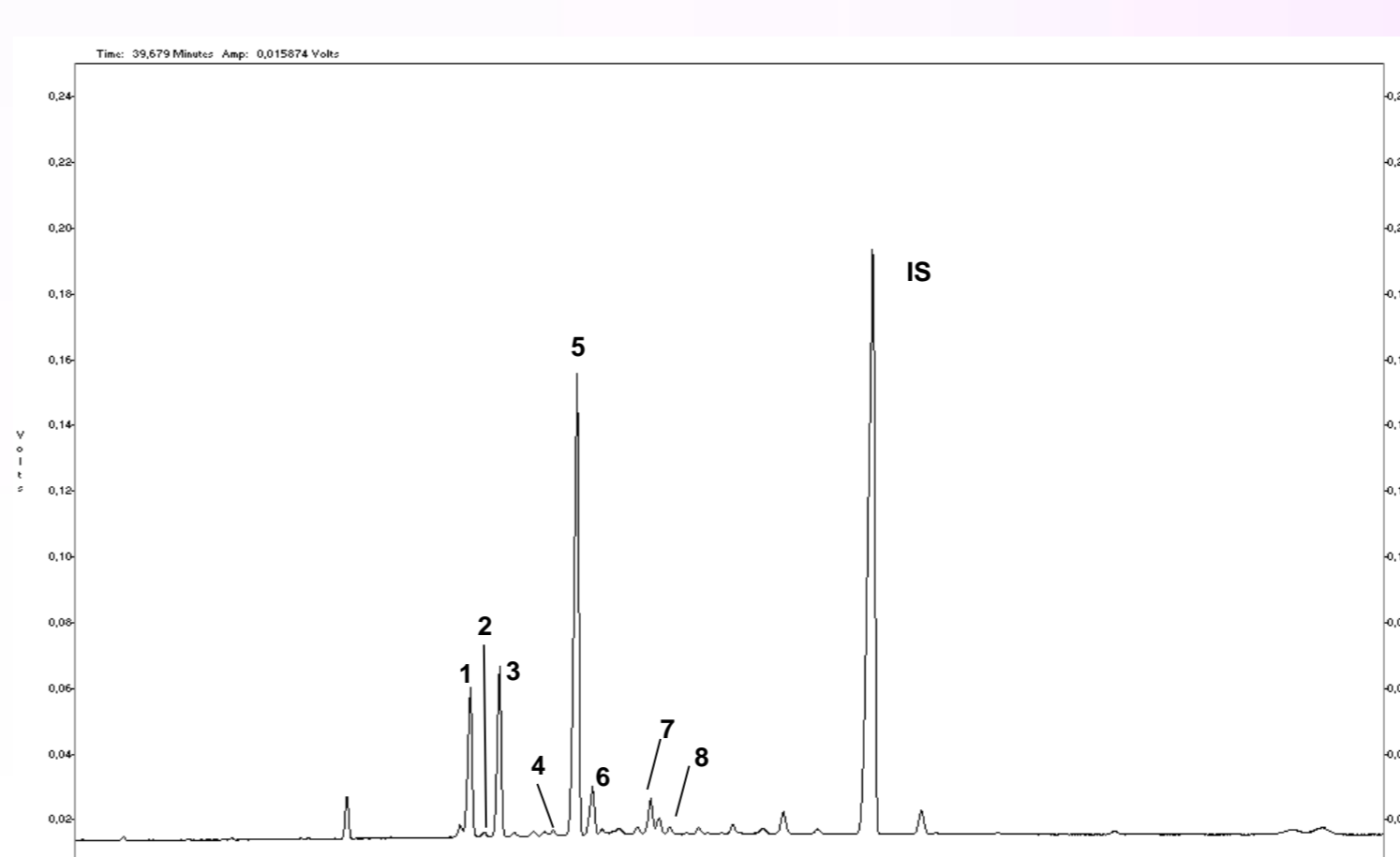


Figure 3A – GC/FID chromatogram for phytosterols analysis.

1: campesterol, 2: campestanol, 3: stigmasterol, 4: clerosterol; 5: β -sitosterol, 6: β -sitostanol + Δ^5 -avenasterol, 7: Δ^7 -stigmasterol, 8: Δ^7 -avenasterol.

Table 1 – Fatty acid content along soybean oil extraction and refining.

Samples	Fatty acids %			
	Saturated	Monounsaturated	Polyunsaturated	Trans isomers
Soybean grain	15.5	25.9	58.6	0.1
Cracked seed	15.5	25.6	58.9	0.1
Laminated seed	15.7	25.6	58.6	0.1
Extruded seed	15.8	25.4	59.0	0.1
Crude oil	15.5	25.5	59.1	0.1
Neutralized oil	15.7	25.3	59.0	0.1
Washed oil	15.7	25.3	59.0	0.1
Bleached oil	15.9	25.3	58.8	0.1
Deodorized oil	15.8	25.6	58.6	0.7

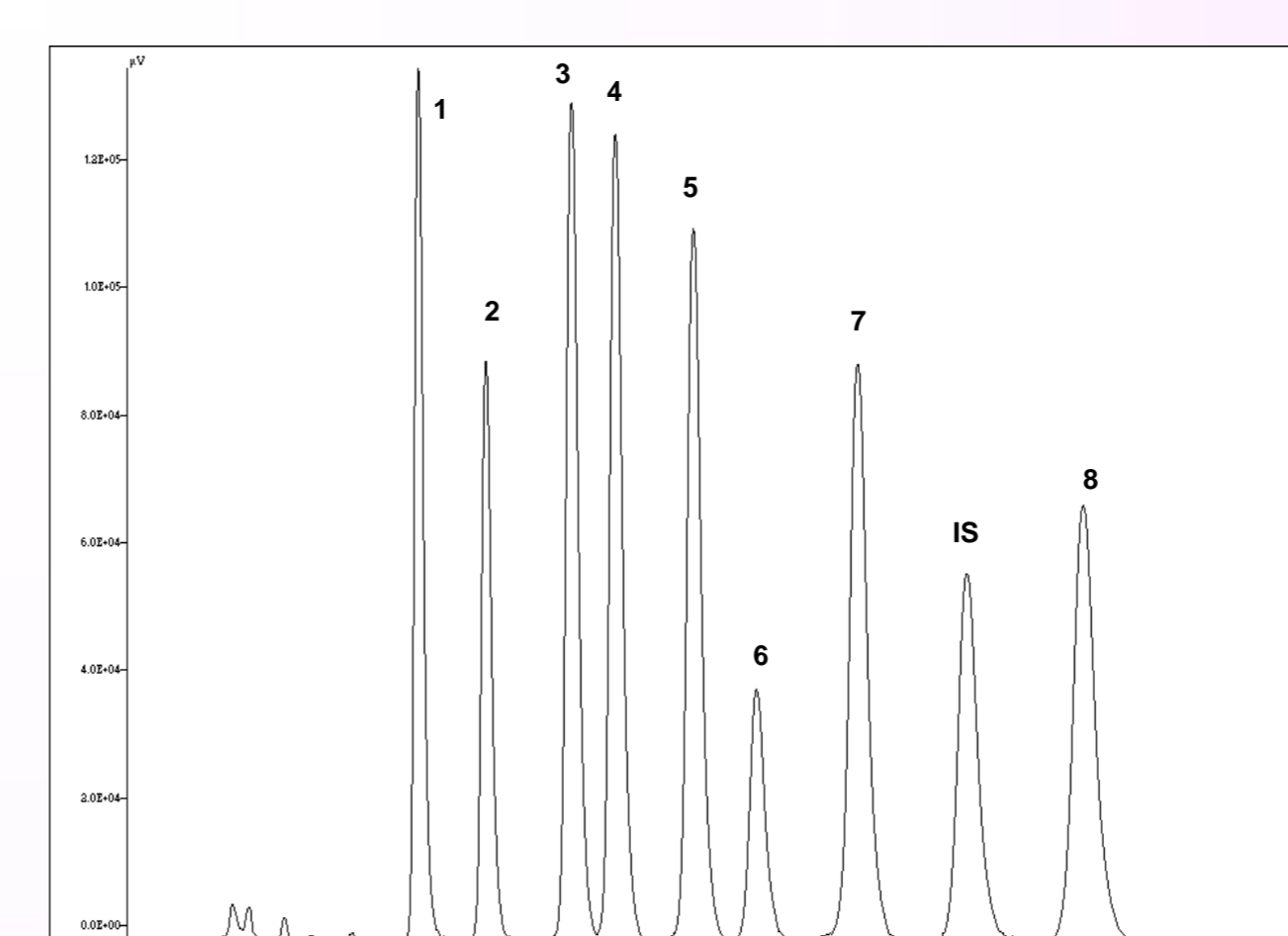


Figure 4A – HPLC/FL chromatogram for a Vitamin E standard mixture.

1: α -tocopherol, 2: α -tocotrienol, 3: β -tocopherol, 4: γ -tocopherol, 5: β -tocotrienol, 6: γ -tocotrienol, 7: δ -tocopherol, 8: δ -tocotrienol, IS: tocol

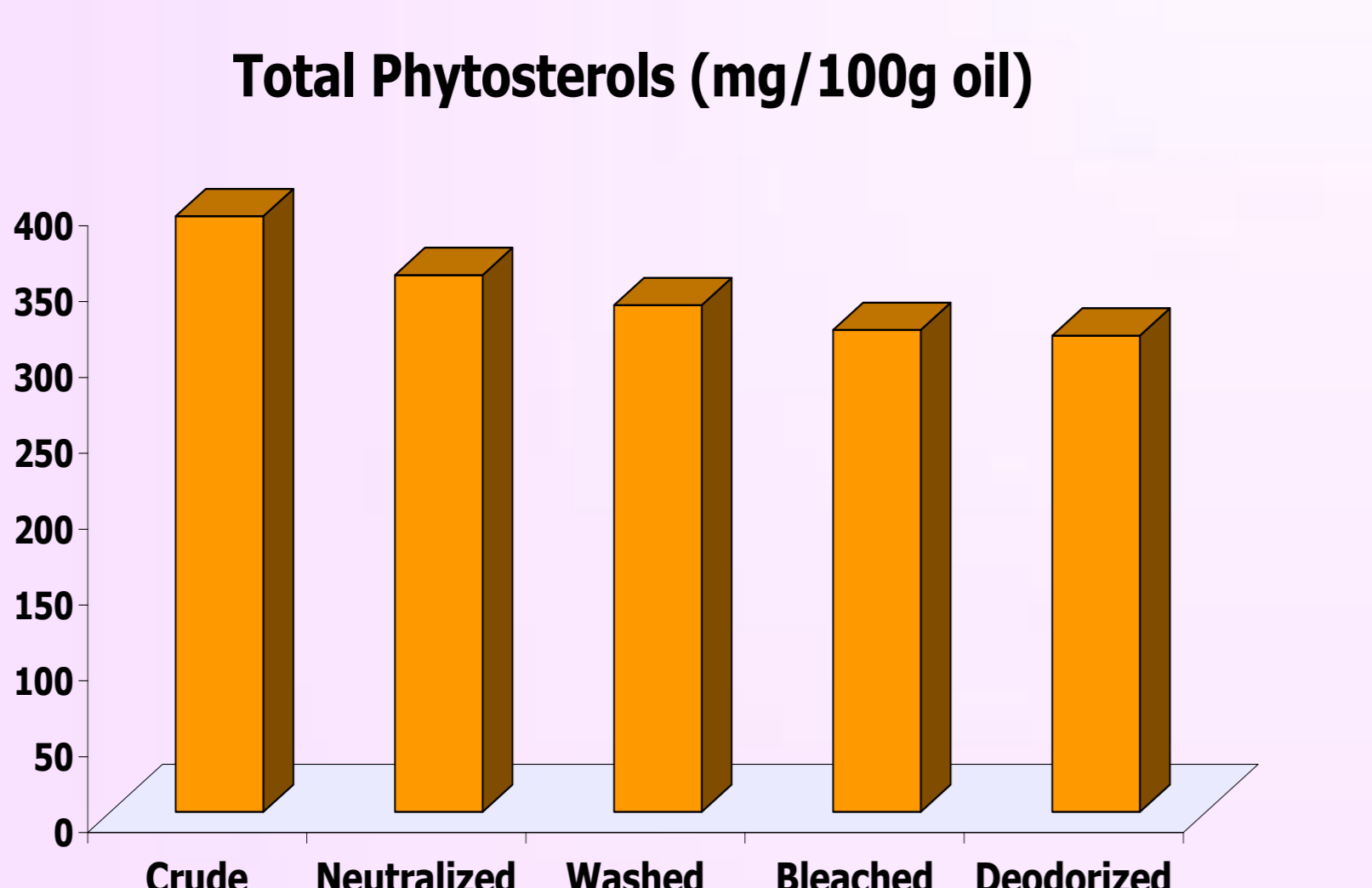


Figure 3B – Total phytosterols content along refining process.

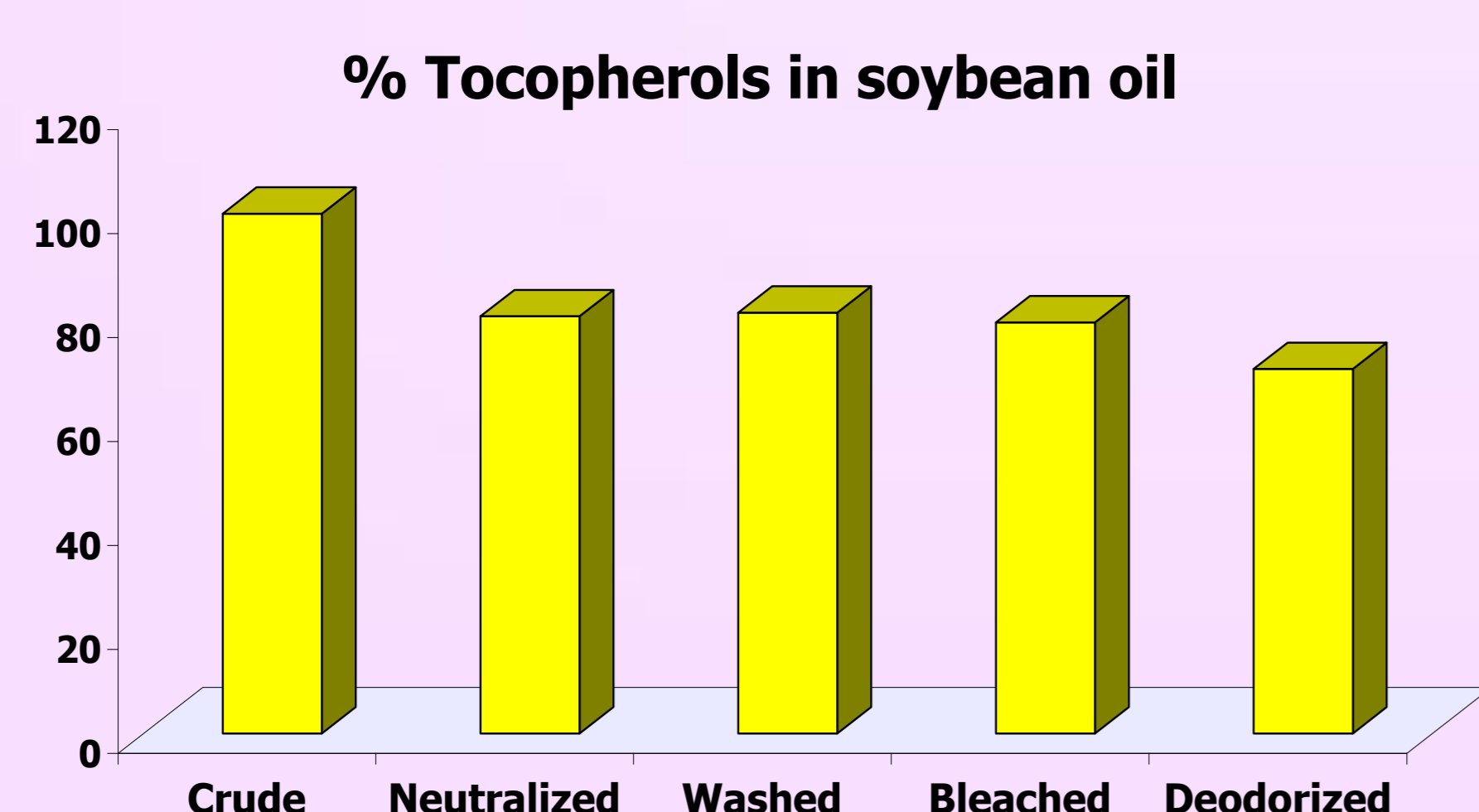


Figure 4B – Evaluation of the Vitamin E content along refining process.

Conclusion:

- ✓ Fatty acid composition did not change significantly along the refining process, except for trans isomers contents that increased (from 0.1% to 0.7%) in the last refining step (deodorization) (Table 1).
- ✓ Total phytosterols content increased along the preparation steps of soybean seeds before solvent extraction (cracking, lamination and extrusion-expelling) probably because those steps showed to be crucial to maximize oil extraction (from 17% to 21%) (figure 2).
- ✓ Refining caused a 20% loss of total phytosterols (from 392.8 to 314.1 mg/100 g oil). A significant reduction of the phytosterols content was observed after neutralization and washing, which could be due to free sterols lost in the soaps micelles² (figure 3).
- ✓ Along crude oil refining, a 30% reduction of Vitamin E content was observed (from 1343.8 to 942.4 mg/kg). The main tocopherols were γ - and δ - isomers while no tocotrienols were detected (figure 4).

References:

- Clive J.; (2006). Global Status of Commercialized Biotech/GM Crops: 2006, ISAAA Brief 35, New York, Ithaca, ISAAA.
- Verleyen, T.; Sosinka, U.; Ioannidou, R.; Verhe, R.; Dewettinck, K.; Huyghbaert, A.; De Greyt, W.(2002). JAOS 79, 947–953.

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