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The Effect of Commercial Soyalecithin on the Physico-Chemical Properties of Some Vegetable Oils

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Abstract: Lecithin determination in crude palm oil, palm kernel oil, soyabean oil and corn oil revealed that the soyabean oil sample has the highest percent lecithin; 2.72% while palm oil sample has the least value; 0.43%. The addition of commercial soyalecithin to the oils resulted to a decrease in the thermal stabilities, cloud points and saponification numbers (S.N) of the crude oil samples. It also resulted to an increase in the iodine values (I.V), the percent free fatty acid (FFA) content as well as a better ability of the oils to withstand cold condition.

Key words: Vegetable oil, lecithin, cloud point, saponification number, iodine value

INTRODUCTION

Vegetable oils are oils from vegetable sources such as palm fruit, palm kernel, cottonseed, soyabean, corn, groundnut etc. The oils are composed of triglycerides of stearic, palmitic, lauric or any other fatty acid and non-glyceride materials. Apart from these fatty acids, other major constituents of vegetable oils are pigments such as carotenoids (and also chlorophyll) which give the oil its red coloration, tocopherol, also known as Vitamin E (anti-oxidant), sterols, phosphatides (phospholipids), glycerides and vitamins (Christie, 1982). Waxes and some free fatty acids (FFA) occur in very small amounts in fats and oils (Neumunz, 1978). Hydrocarbons such as squalene, are also present in some naturals fats and oils (Hilditch, 1956).

However, some of the purified oils and fats contain only very small amounts of other compounds but these have little or no effect on the flavour, colour or development of rancidity. In the crude oils, particularly those from seeds, there are considerable quantities of Phospholipids and other lipids which have not been completely identified (Meyer, 1960). Sterols also occur in crude fat or oil both as esters of fatty acids.

Lecithin is class of phospholipids. It is a triglyceride with one fatty acid replaced by a phosphoric acid ester of choline. It is waxy and soluble in fats and oils. Lecithin is a nutural emulsifier, instanizer, antioxidant and flavour protector that is particularly useful in confectionary manufacturing. Its commercial source is soyabean (Kirk-Othmer, 1995).

It is very common with palm/palm kernel oils to crystallize (Solidify) at atmospheric temperature while oils from oil seeds such as soyabean and corn remain clearly liquid even when refrigerated.

This study presents the lecithin content of these oils and also the effect of treating these oil samples with commercial soyalecithin.

MATERIALS AND METHODS

The soyabean (*Glycine marx*) seeds, corn (*Zea mays*) kernel, palm fruits and palm kernel were obtained from the Umuahia main market, Abia State, Nigeria. The commercial soyalecithin was obtained from a pharmaceutical industry in Lagos; Nigeria.

The corn kernel, dehulled soyabean seeds and the palm kernel were separately milled and their oils extracted with a 50:50 mixture of Ethanol and n-Hexane, in a soxhlet extractor for 4 h.

The palm oil fruits were cooked for 3 h and marshed. The oil was solvent extracted firstly, with Ethanol and secondly with n-Hexane. The 2 extracts were then mixed together and used for the tests.

The lecithin content of the oil samples were determined according to the method described by Paul *et al.* (2004). To each of the oil samples, 10cm^3 of the soyalecithin was added and the volume of the oil made up to 200 cm^3. The mixture was dissolved in ethanol and refluxed for 2 h. This implies an increase in the lecithin content of each of the oil samples by 5%. The following tests were carried out on the samples before and after the addition of the soyalecithin.

The thermal stabilities, cloud points and cold stand were determined as described by Ogbuagu (1996). The cloud point determination of soyabean and corn oil samples were made in the micro freezer.

Specific gravity: This was determined by the density bottle method (Nelkon, 1981).

The saponification number (S.N), iodine value (I.V) and the free fatty acid (FFA) determinations were made using the titrimetric method (Pearson, 1979).

RESULTS AND DISCUSSION

The lecithin content of the unrefined (crude) oil samples are shown in Table 1. Crude soyabean oil has the highest value of 2.72% while the crude palm oil has the lowest value of 0.43%. Soyabean has been reported as a commercial source of lecithin (Kirk-Othmer, 1995). Cereals such as corn also have considerable amount of lecithin. The phosphatide contents of freshly extracted corn and soyabean oils have been reported to be between 2-3% (Hilditch, 1956; Wittcoff, 1951). This, however, depends on a lot of factors and may be higher or lower as the case may be.

Some of the physical properties of the untreated oil samples are presented in Table 2a.

There are marked effects on the physical properties of the oil samples with addition of the soyalecithin.

The cloud points of the oil samples reduced and with improved ability of the oil samples to withstand refrigerator temperature as expressed in the cold stand. Lecithin has been employed by food processors to minimize sticking in confectionery manufacture. It also reduces viscosity, improves wetting and lowers melting point by several degrees (Kirk-Othmer, 1995). It is also used in the nonfood industries. Lecithin is a crystal inhibitor and prevents or reduces cloud formation in oils. Hence, the observed changes.

Soyabean and corn oils, treated with soyalecithin, did not form cloud at all, but the treated palm and palm kernel oils formed cloud but at very reduced (low) temperatures. The abilities of palm and palm kernel oils to remain liquid were also improved as the solidified mass, under the refrigerator temperature, melted within 20 min on being brought out of the refrigerator (Table 2b) as against the untreated samples which melted within 15 h on being brought out of the refrigerator (Table 2a).

The decrease in the thermal stabilities of the treated oil samples (Table 2b) resulted from the increase in the free fatty acid (FFA) content of the treated oil samples (Table 3b). FFA content of a fat or oil affects its thermal stability as an increase in FFA content decreases the thermal stability and vice versa.

The chemical properties of the untreated oil samples are presented in Table 3a.

The chemical properties were also affected as a result of the addition of the soyalecithin.

The saponificaiton number (S.N) decreased (except in crude soyabean oil) while the iodine value (I.V) and FFA increased (Table 3b).

The decrease in the S.N. indicates an increase in the average molecular weight (or chain length) of the oil samples. The treatment has no appreciable effect on the S.N. of soyabean and corn oils. This implies that the addition of soyalecithin has no effect on the average molecular weight (or chain length) of soyabean oil and no appreciable effect on the average molecular weight (or chain length) of corn oil. This may be attributed to the fact that soyabean and corn oils are composed of very long chain fatty acids and are also natural sources of phosphatides.

Table 1: Lecithin content of the crude oil samples

Oil samples	Lecithin content (%)
Crude palm oil	0.43
Crude palm kernel oil	0.76
Crude soyabean oil	2.72
Crude corn oil	1.25

Table 2a: Physical properties of the untreated oil samples

Oil samples	S.G	Smoke Pt. (°C)	Flash Pt. (°C)	Fire Pt. (°C)	Cloud Pt. (°C)	Cold Stand
Crude palm oil	0.8916	85	129	142	25	15 h (Solidified)
Crude palm kernel oil	0.8980	120	173	202	26	15 h (Solidified)
Crude soyabean oil	0.9204	187	222	253	-2	+
Crude corn oil	0.9174	146	211	240	3	+

+… passed the cold stand (No solidification)

Table 2b: Physical properties of the treated oil samples

Oil samples	S.G	Smoke Pt. (°C)	Flash Pt. (°C)	Fire Pt. (°C)	Cloud Pt. (°C)	Cold Stand
Crude palm oil	0.9120	82	125	140	9	20 min
Crude palm kernel oil	0.9128	112	165	196	3	20 min
Crude soyabean oil	0.9218	180	218	240	Nil	+
Crude corn oil	0.9178	142	205	220	Nil	+

+… passed the cold stand (No solidification)

Table 3a: Chemical properties of the untreated oil samples

Oil samples	Saponification Number (S.N)	Iodine Value (I.V)	Free Fatty Acid (FFA) (%)
Crude palm oil	245.44	28.62	0.76
Crude palm kernel oil	281.20	46.70	0.48
Crude soyabean oil	189	105.33	0.37
Crude corn oil	195	88.83	0.49

Table 3b: Chemical properties of the treated oil samples

Oil samples	Saponification Number (S.N)	Iodine Value (I.V)	Free Fatty Acid (FFA) (%)
Crude palm oil	30	210	0.84
Crude palm kernel oil	47.70	200.3	0.67
Crude soyabean oil	190	188	0.56
Crude corn oil	198	193	0.58

The increase in the I.V. indicates an increase in the unsaturation of the oil samples as a result of the addition of the soyalecithin. Phosphatides in general, contain a C_{16} or C_{18} saturated fatty acid at C_1 and C_{18} to C_{20} unsaturated fatty acid at C_2 (Lehninger, 1982). This implies that the unsaturated fatty acid dominates in phosphatides in general more than the saturated fatty acid, thereby increasing the unsaturation of the oils treated with the soyalecithin. The inrease in the free fatty acid (FFA) content of the treated oil samples must have resulted from the FFA contribution from the soyalecithin. This observation also agrees with the result of specific gravities of the oil samples which increased (though slightly) after the addition of the soyalecithin, as specific gravity increases with increase in unsaturation of oils (Njoku, 2001).

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