Palm kernel oil analysis

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Different triglycerides have different molecular morphologies and molecular scales because of the carbon chain length of fatty acids, the number and configuration of unsaturated bonds (position, cis-trans isomerization), and their steric distribution on glycerol groups; Due to the different ways of hydrocarbon chain aggregation in crystal subcells, different triglycerides have different crystal structures and unique polymorphic characteristics, and the degree of compatibility between them is very different. There are four cases in which the two components are compatible:
1 is fully compatible, they can be mixed in any proportion, and the mixture exhibits a continuous solid state;
2 partially compatible, the mixture of the two components exhibits a eutectic state, and mixing at a certain ratio will obtain the lowest melting point;
Part 3 is compatible, but the mixture exhibits a phenomenon of partial crystal, that is, a single component occurs within a certain ratio; 4 the two components are incompatible with each other, and the mixture exhibits a mutual blend of crystals. The coexistence of forms. Natural oils, or oils after hydrogenation, fractionation, and lactide are a mixture of various triglycerides. In a strict sense, they are not a "single" component, but a triglyceride composition of one fat is another. In terms of fats and oils, it is relatively unchanged. After mixing the two oils and fats, a binary isothermal phase diagram can be made according to the above theory.
[1], using phase diagrams to study its compatibility. Palm kernel oil is an associated product of palm oil, and its output grows steadily with the rapid development of the oil palm industry.
[2], the application of margarine, shortening, candy, etc. is increasingly widespread. Therefore, understanding and studying the compatibility between palm kernel oil and other oils is instructive for the fat phase ratio, processing and storage of special grease products.

1 Materials and methods
1.1 Raw materials Palm kernel oil, palm oil, hydrogenated palm oil, palm oil soft fat, palm oil hard fat and tallow, provided by Donghai Grain and Oil Industry Co., Ltd.
1.2 Instruments, equipment Shimadzu GC - 14B gas chromatograph; M inispec120 nuclear magnetic resonance instrument.
1.3 Analytical methods 1.3.1 Analysis of compatibility The content of palm kernel oil in the mixture is plotted on the abscissa and the solid fat content (SFC) is plotted on the ordinate. The compatibility of the two oils can be described by an isothermal curve or by the difference between the measured SFC value of the mixture and its theoretical SFC value (?SFC) [1]. The theoretical SFC value is calculated as follows: SFC theory = x% SFCx + y% SFCy [3] where x% and y% represent the concentration (%) of the x and y components in the mixture, respectively; SFCx and SFCy respectively represent The measured SFC value of the x and y components at temperature. Taking the temperature as the abscissa and ?SFC as the ordinate, the deviation curve between the measured SFC value and the theoretical SFC value is plotted. If the measured SFC value is higher than the theoretical SFC value, the crystal phenomenon occurs; otherwise, the eutectic phenomenon occurs.
1.3.2 Fatty acid composition by gas chromatography
[4] Analyze the fatty acid composition of fats and oils. Chromatographic conditions: capillary

column SP - 2380, 60m × 0.32 mm; column temperature 180 ° C; injection temperature 230 ° C; FID detector; detector temperature 230 ° C; carrier gas (N2) pressure 100 kPa; H2 pressure 60 kPa; The pressure is 50 kPa.
1.3.3 Melting point The rising melting point (SMP) of the oil is determined by the AOCS Cc3 - 25 method.
1.3.4 Solid fat content (SFC) using nuclear magnetic resonance method [5]

Analyze the SFC value of the grease. Instrument parameters: DUR2: 59 s; DUR1:
11 s; OFFSET: 0.135; CONS: 1.47; ENH: 38; RD: 2.000.
2 Results and discussion 2.1 Properties of feedstock oil 2.1.1 Fatty acid composition (see Table 1) Table 1 Main fatty acid composition of each feedstock oil (%)

It can be seen from Table 1 that the biggest difference between palm kernel oil and other oils is that it is rich in lauric acid (C12: 0). The fatty acid composition of other oils is mainly palmitic acid (C16: 0), stearic acid (C18: 0) and Oleic acid (C18: 1). 2.1.2 Melting point (see Table 2) Table 2 Melting point of each raw material oil (°C, SMP)

It can be seen from Table 3 that the melting curve of palm kernel oil is steep and the plasticity range is limited, indicating that the melting point of palm kernel oil triglyceride is narrow. Other feedstocks have a wide plastic range. The difference in plasticity between palm kernel oil and other oils reflects the difference in triglycerides.
2.2 Palm kernel oil mixed with palm oil Two different isothermal phase diagrams of palm kernel oil and palm oil are shown in Figure 1.
Fig.1 Isotherm curve of palm kernel oil and palm oil Calculate the theoretical SFC value according to the SFC value in Fig. 1, and draw the deviation curve between the measured SFC value and the theoretical SFC value of palm kernel oil and palm oil, as shown in Fig. 2.
Figure 2 Palm kernel oil and palm oil measured SFC value
Deviation curve from theoretical SFC value It is a very effective and fast method to analyze the compatibility between oil and fat by using isothermal curve. A completely compatible binary mixture has an isotherm curve in a straight line. It can be seen from Fig. 1 and Fig. 2 that eutectic phenomenon occurs in the mixture of palm kernel oil and palm oil, especially at 20 °C, when the palm kernel oil content is 30% to 50%, the eutectic phenomenon is the most serious. LarsHerngvist [6] believes that mixed triglycerides consisting of two triglycerides with widely different fatty acid chain lengths will produce their respective crystals during the crystallization process. Therefore, a mixture of palm kernel oil containing a large amount of lauric acid (C12:0) and a palm oil mixture mainly composed of palmitic acid (C16:0) inevitably undergoes crystallization during crystallization.
2.3 Palm kernel oil mixed with palm oil stearin The isothermal curves of palm kernel oil and palm oil stearin in different proportions are shown in Figure 3.
The SFC values of palm kernel oil and palm oil hard fat measured and the deviation curves of calculated SFC values are shown in Fig. 4.
Figure 4 Palm oil and palm oil hard fat measured SFC value and theoretical SFC value deviation curve As can be seen from Figure 3, palm kernel oil and palm oil hard fat mixed system compatibility is very poor. It can also be seen from the deviation curve of Fig. 4 that the eutectic phenomenon of this mixed system is very serious, except that the compatibility is better at 40% of the palm kernel oil content, and the eutectic phenomenon is exhibited at each

temperature point of other ratios, among which When the palm kernel oil content is 30%, 50%, 60% at 20 °C, the eutectic phenomenon is most serious when the palm kernel oil content is 50% to 70% at 25 °C, and the ?SFC can reach -11% to -14%. This is because the melting point of palm kernel oil and palm oil hard fat is too large, and the melting characteristics are also very different, so phase separation is easy to occur when the temperature changes, and should be used with caution in practical applications.

2.4 Palm Kernel Oil and Palm Oil Soft Fat Mix The isothermal curves of palm kernel oil and palm oil soft fat in different proportions are shown in Figure 5.

Figure 5 Isotherm curve of palm kernel oil and palm oil fat

Different ratios of palm kernel oil and palm oil soft fat measured SFC value

It can be seen from Fig. 5 that each isothermal curve is not a straight line, indicating that the incompatibility between the two is serious, especially in the range of 15 to 20 °C. It can be more clearly seen in Fig. 6 that eutectic phenomenon occurs at less than 30 °C, and the eutectic phenomenon is most serious when the palm kernel oil content is 30% to 60% at 20 °C. This is because although the melting point of palm kernel oil and palm oil soft fat is very close, there is a big difference between their fatty acid composition, triglyceride composition and isomorphous nature. 2.5 Palm kernel oil mixed with hydrogenated palm oil The isothermal curves of different proportions of palm kernel oil and hydrogenated palm oil are shown in Figure 7.

Figure 7 Isotherm curve of palm kernel oil and hydrogenated palm oil

The measured SFC values of different proportions of palm kernel oil and hydrogenated palm oil and the calculated SFC value deviation curve are shown in Fig. 8.

Figure 8 Palm oil and hydrogenated palm oil measured SFC value and theoretical SFC value deviation curve From the curve of Figure 7 and the deviation curve of Figure 8, it can be seen that at 25 ° C, palm kernel oil content within 40% ~ 80%

In the temperature range of 25 °C, the SFC value is less than 10 and the plasticity is lost. It can be seen from Fig. 10 that the variation of the difference in this binary system is more complicated in the entire composition ratio interval. In the range of 0 ~ 10 °C, the phenomenon of eccentricity occurs, and after more than 15 °C, eutectic phenomenon occurs, especially the palm kernel oil content of 30 ° C to 60% at 20 ° C, and the palm kernel oil content of 25 ° C is 40% to 70%. The eutectic phenomenon is the most serious. Care should be taken in product formulations.

3 Conclusion

The mixture of palm kernel oil and palm oil series oil has serious eutectic phenomenon in the range of 20 ~ 25 °C, and the change is more complicated when mixed with tallow, and the crystal phenomenon occurs in the range of less than 10 °C, in the range of 20 ~ 25 °C. Serious eutectic phenomena appear. This property of palm kernel oil should be given special attention when studying margarine and shortening formulations; of course, certain special-purpose greases (such as soft margarine) need to be used at lower temperatures and require good plasticity. It has a sense of standing and taste, and this eutectic phenomenon can be used to make a reasonable adjustment of the formula.