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OPTIMIZATION OF ROASTING PROCESS AND PRODUCT QUALITY OF PEANUTS

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Differential scanning calorimetry (DSC) was used to establish criteria for optimization of raw material selection, roasting process, eating quality, visual appearance, and shelf-life extension of peanuts [1–4]. DSC methods were developed as both predictive and analytical tools to define process operating guidelines and to correlate with traditional quality attributes of roasted peanuts [1–4].

Keywords: *DSC, oil-roasting process, peanuts, product quality*

Experimental

Details of DSC methodology, described previously elsewhere [1–5], are illustrated in the legend material of various Figures shown in the following section.

Results and discussion

Figure 1, a DSC-measured 'thermal response profile' for blanched Virginia peanuts (with about 5% 'as is' moisture content), illustrates the temperature and time conditions of optimized oil-roasting (i.e. 300–325°F for 5–8 min), which result in optimum finished-product texture and/or optimum product flavor and color, as determined by the effect of extent of roasting on the peanut's levels of residual undenatured arachin and non-arachin protein fractions.

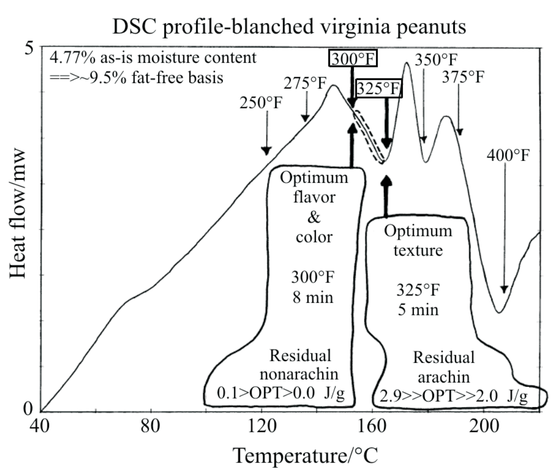

Fig. 1 Thermal response profile for blanched VA peanuts

Figure 2 shows DSC profiles for a sample of raw Virginia peanut (1:1 with water). An initial heating scan shows a sequence of endotherms for fat melting, starch gelatinization, and protein denaturation of the non-arachin (smaller, lower-temperature peak) and arachin (larger, higher-T peak) fractions, while an immediate rescan shows only the reappearance of fat-melting.

Figures 3 and 4 show DSC profiles for samples of blanched and over-roasted peanuts (1:1 with water), respectively. The heating scan in Fig. 3 shows a much smaller starch gelatinization endotherm than that in Fig. 2, indicating that some gelatinization had already occurred during blanching, whereas the denaturation peaks for non-arachin and arachin appear similar in size to those in Fig. 2, suggesting that blanching had not resulted in any significant protein denaturation. In comparison, the heating scan in Fig. 4 shows an even smaller residual starch gelatinization peak, while the (lower-T) non-arachin peak appears to be completely absent (i.e. non-arachin totally denatured, due to over-roasting), and the (higher-T) arachin peak

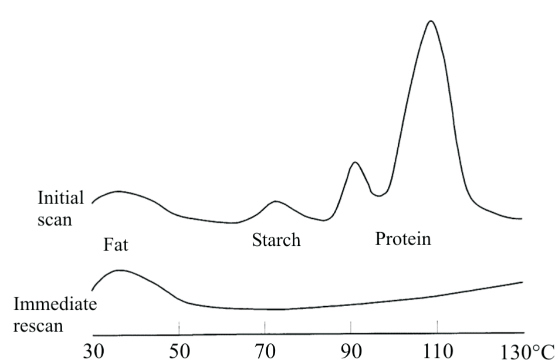

Fig. 2 DSC profile of raw peanut VA910212 1991 harvest medium size kernel (equal masses of ground peanut & water)

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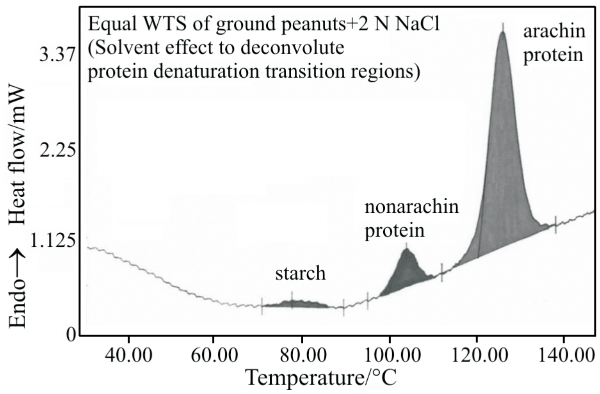

Fig. 3 DSC profile for blanched peanut

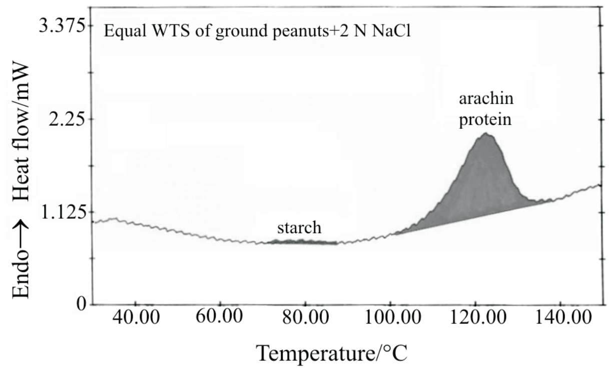

Fig. 4 DSC profile for over-roasted peanut

appears to be broadened and much reduced in size (i.e. arachin partially denatured, due to over-roasting at too high a temperature).

Figure 5 shows a sequence of five DSC profiles for samples of whole medium-sized Virginia peanuts (1:1 with water) taken at different steps along an oil-roasting process, from blanched, to 1/3, 2/3 and fully roasted, to finished product. The most obvious features of these heating scans are the gradual disappearance of the (lower-T) non-arachin denaturation peak, and the continually decreasing size of the (higher-T) arachin denaturation peak, as roasting progresses.

Figure 6 shows a set of DSC profiles for samples of medium Virginia peanuts (1:1 with water), representing unfractionated whole-nut finished product in comparison to split-nut finished product fractionated into three subpopulations on the basis of visual color:

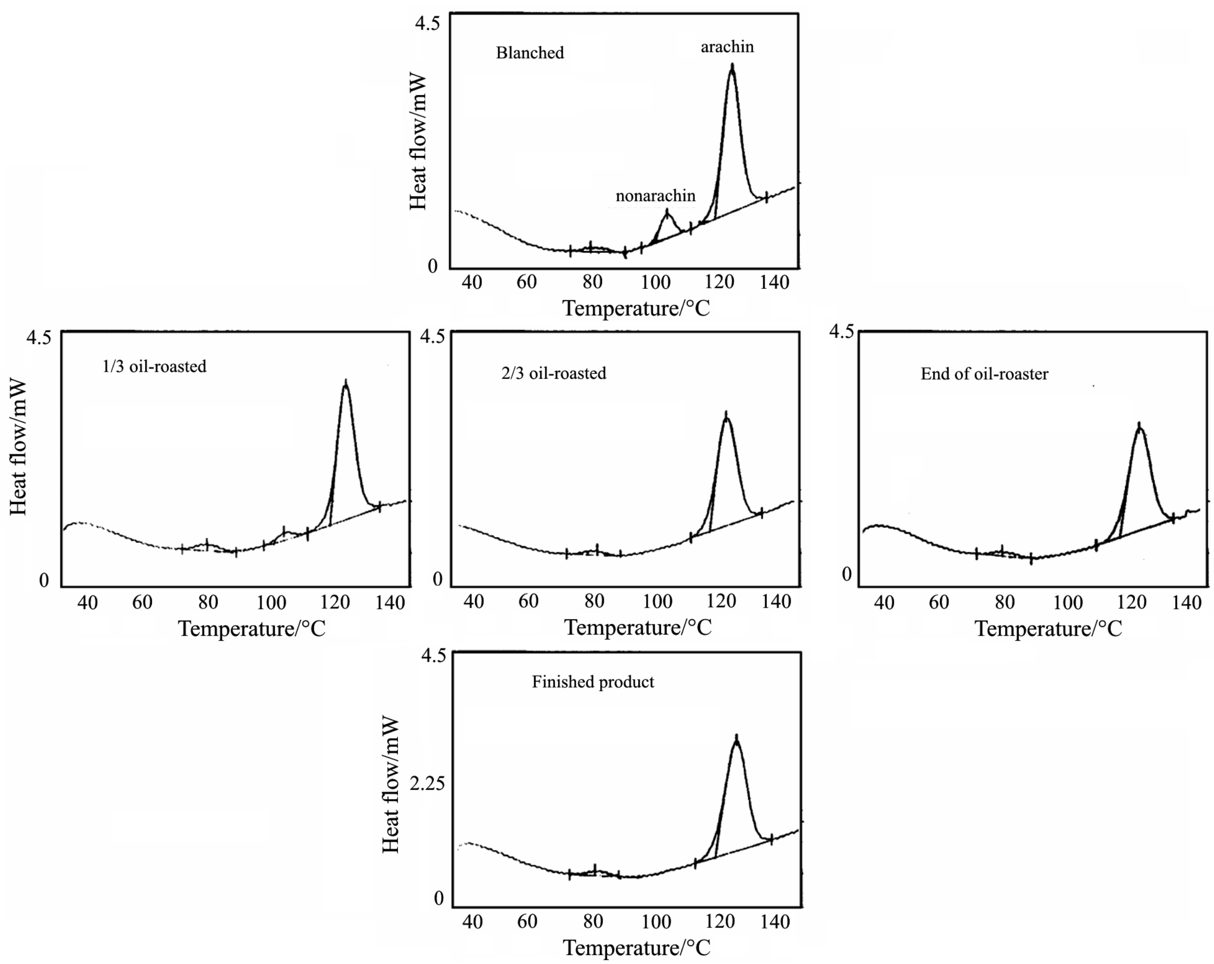

Fig. 5 DSC profiles for peanut samples along an oil-roasting process

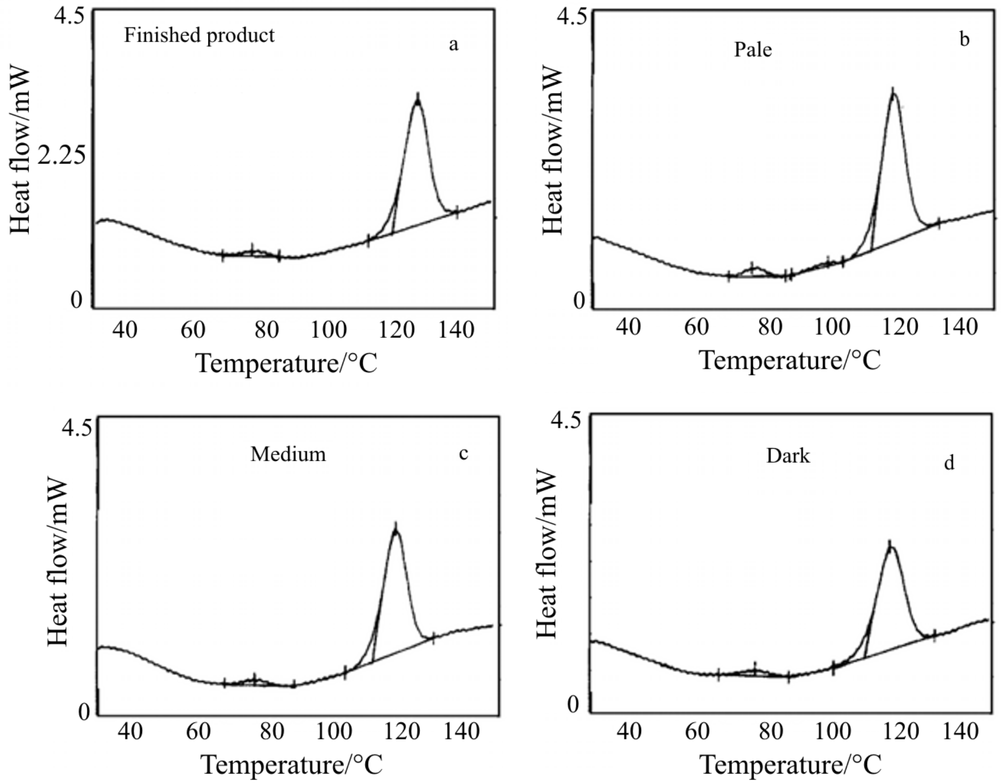

Fig. 6 DSC profiles; a – unfractionated whole peanuts; b, c, d – color-fractionated splits

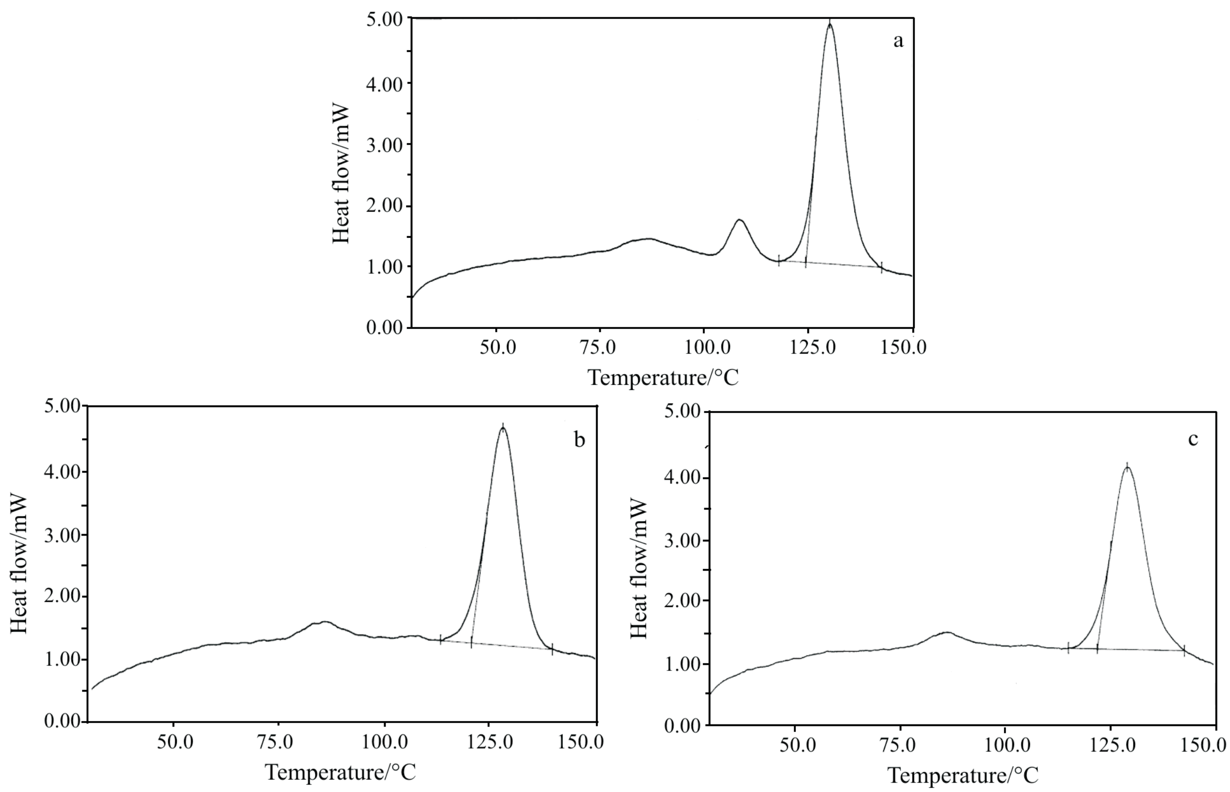

Fig. 7 DSC profiles for peanut samples 1:1 in 12 mass% NaCl solution: a – blanched; b – mildly roasted; c – heavily roasted

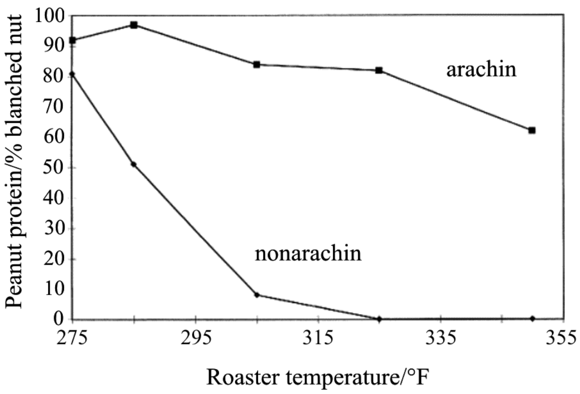

Fig. 8 DSC analysis of peanut roasting process optimization

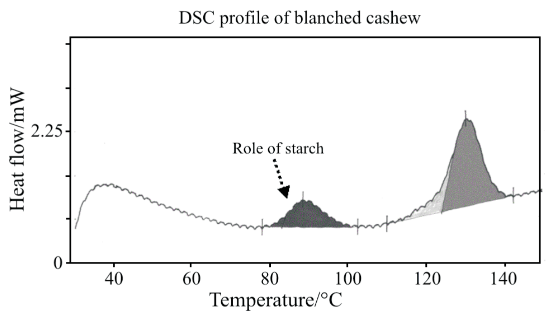

Fig. 9 DSC profile for blanched cashew

pale, medium and dark. In the latter three heating scans, we see a clear trend of continually decreasing size of the (higher-T) arachin denaturation peak, as roast color goes from pale to dark (Figs 6b–d,) while only the pale-colored (i.e. most lightly roasted) splits show any residual (lower-T) non-arachin denaturation peak.

Figure 7a–c shows a set of three DSC profiles for peanut samples analyzed 1:1 by mass in a solution of 12 mass% NaCl in water, rather than in water alone. Use of such a NaCl solution allows enhanced resolution between the (lower-T) non-arachin and (higher-T) arachin denaturation peaks in a DSC heating scan, so that one can observe more clearly the disappearance of the non-arachin peak, as a function of increasing extent of thermal processing. (The same kind of enhanced resolution, through the use of a NaCl solution rather than water alone, has been reported previously [6] from DSC analysis of the thermal denaturation of the (lower-T) conglycinin and (higher-T) glycinin protein fractions in soy flour.) In the heating scan for blanched peanuts in Fig. 7a, the (lower-T) non-arachin peak is prominently displayed. In contrast, in Fig. 7b, for peanuts lab-roasted for 6 min at 320°F, the non-arachin peak has nearly disappeared, while the (higher-T) arachin peak is essentially the same size as that in 7a. In Fig. 7c, for peanuts roasted even more extensively than those represented in 7b, the non-arachin peak is almost completely absent, while the (higher-T) arachin peak has been reduced in size by only about 10%.

Figure 8 shows a plot of % remaining undenatured peanut proteins *vs*. oil-roaster temperature, which conceptually illustrates how we have been able to use DSC analysis to understand the optimization of a peanut roasting process. The plot reveals that the non-arachin fraction (with lower denaturation temperature) is much more extensively denatured than is the arachin fraction (with higher denaturation *T*), with increasing roasting temperature in the range from 275 to 350°F.

Figure 9 shows a DSC profile for a sample of blanched cashew (1:1 with water). In this heating scan, the most noteworthy feature is the much more prominent starch gelatinization endotherm, which is much larger, relative to the size of the higher-T protein denaturation peak, than is the case illustrated earlier for peanuts. This finding suggests a correspondingly greater potential contribution from gelatinized starch to the finished-product texture and mouthfeel of roasted cashews, in comparison to peanuts.

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