Air/liquid Partition Coefficients in Lipidic Media* - Relation with RP-HPLC Capacity Factors.

G. Piraprez & S. Collin

Unité de Brasserie et des Industries Alimentaires, Université Catholique de Louvain, Place Croix du Sud 2/Bte7, B-1348 Louvain-la-Neuve, Belgium

* determined in Prof. Voilley's Laboratory (ENSBANA-Dijon) during a short-scientific mission fiananced by the Cost Action 96.

In order to quantify flavour retention by lipids, air/liquid partition coefficients « k » of four methylketones (butanone-2, pentanone-2, hexanone-2 and heptanone-2) were determined by an hyphenated dynamic headspace-gas chromatographic system (Figure 1). Air/liquid partition coefficient is defined by the ratio C_g/C_l with C_g, the aroma concentration in the gas phase and C_l, the aroma concentration in the liquid phase. Theoretically, in absence of lipids, the air/water partition coefficient of flavouring compounds belonging to a same family increases with their chain length. This theoretical pattern is not true in more complex systems.

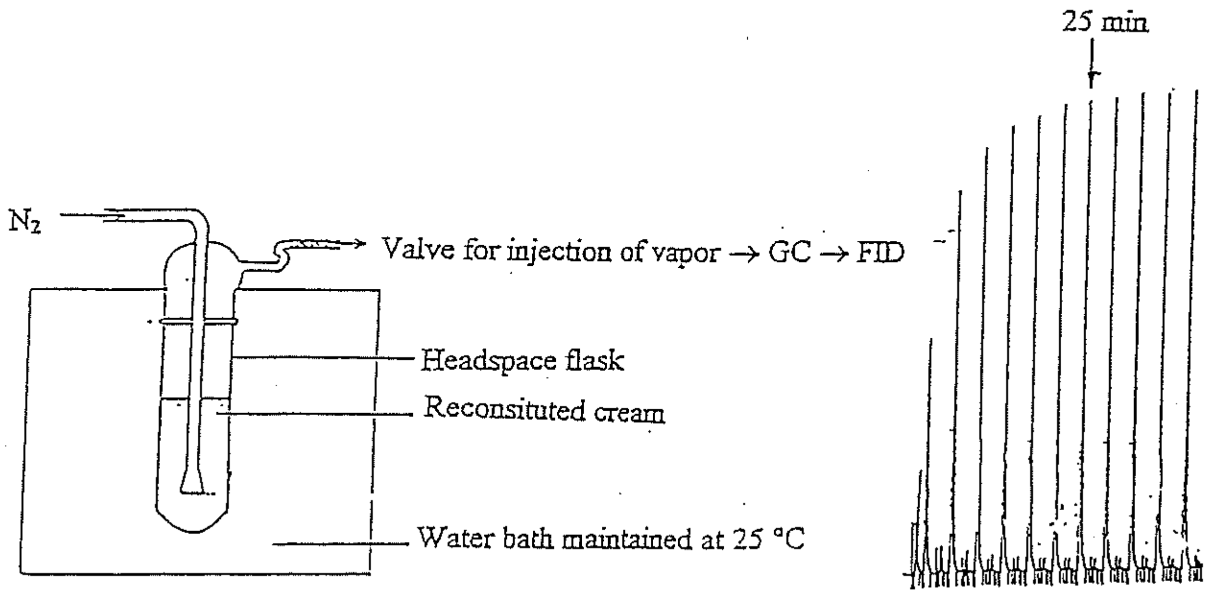

Figure 1. (a) Headspace analysis (b) Chromatogram

Experiments were operated in a reconstituted cream. The emulsion between butter oil and a mixture of water, butter milk powder and carraghenanes was obtained by an ultra speed agitator (Ultra-turrax®). In order to show the influence of fat on aroma retention, reconstituted creams were prepared with increasing amounts of lipids and a parallel decrease of water. By this way, « light » creams without added butter oil and high fatty systems containing 40 % (w/w) of butter oil were obtained. Intermediate compositions were also tested (5, 10 and 20 %). Aroma compounds were added two hours before sampling. After a 25 °C thermostatisation, hundred grams of cream were poured into the headspace flask and purged by a nitrogen flow at 30 ml/min (Figure 1). One ml of the gaseous phase was automatically injected at fixed interval of time. For all the samples, equilibrium was obtained after 25 minutes of purge.

As shown in Figure 2, the methylketones air/liquid partition coefficients usually decrease when the butter oil content increases, suggesting that favourable interactions can occur between the flavouring substances and the lipids. However, this retention phenomenon appears to be highly dependent on the chemical structure of the aroma compound. Butanone-2 seems to be unaffected by the butter oil content. This compound shows already a distinct behaviour without addition of butter oil; its solubility in water significantly decreases the concentration which is measured in the gas phase. For the other compounds, the lipid retention phenomenon increases with their chain length.

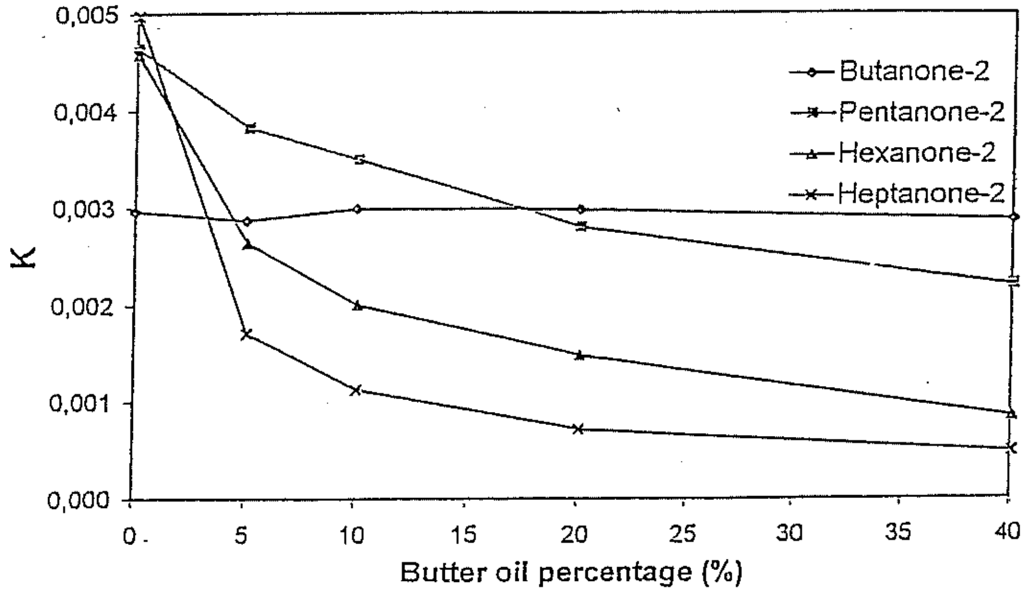

Figure 2. Air/liquid partition coefficients, k, in function of the butter oil percentage (%).

The butter oil impact can be depicted by a relative K_r value which normalizes each data in comparison with the non-fatty system (Figure 3) : $K_r = \frac{K_{x\,\%\,\text{butter oil}}}{K_{0\,\%\,\text{butter oil}}} * 100$ (%). Similar curves have been previously obtained between the dynamic headspace relative response coefficients and the triolein amount added in a fresh cheese sample (Piraprez *et al*, 1997a).

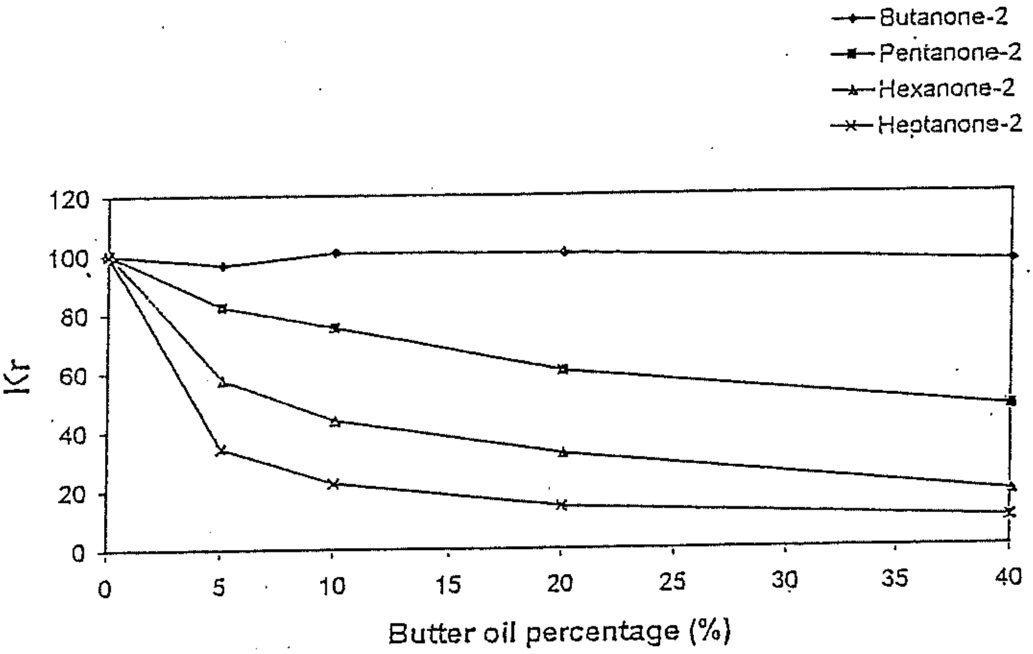

Figure 3. Relative air/liquid partition coefficients, k_r, in function of the butter oil percentage (%).

When the relative k_r values are given in function of a lipophilicity index such as log k_w values (Piraprez *et al*, 1997b), a mathematical relationship (an inverse power function) (Figure 4) can be calculated allowing us to quantify the hydrophobic interactions which occur. Logically, the higher the butter oil percentage, the smaller the exponent value. $1/k_r$ (= retention) and k_w can therefore be correlated for each butter oil contents by the following equations :

Methylketones				r2
retention	(5 % butter oil)	=	0,42 k_W	0,993
retention	(10 % butter oil)	=	0,78 k_W	0,993
retention	(20 % butter oil)	=	1,34 k_W	0,966
retention	(40 % butter oil)	=	2,06 k_W	0,966

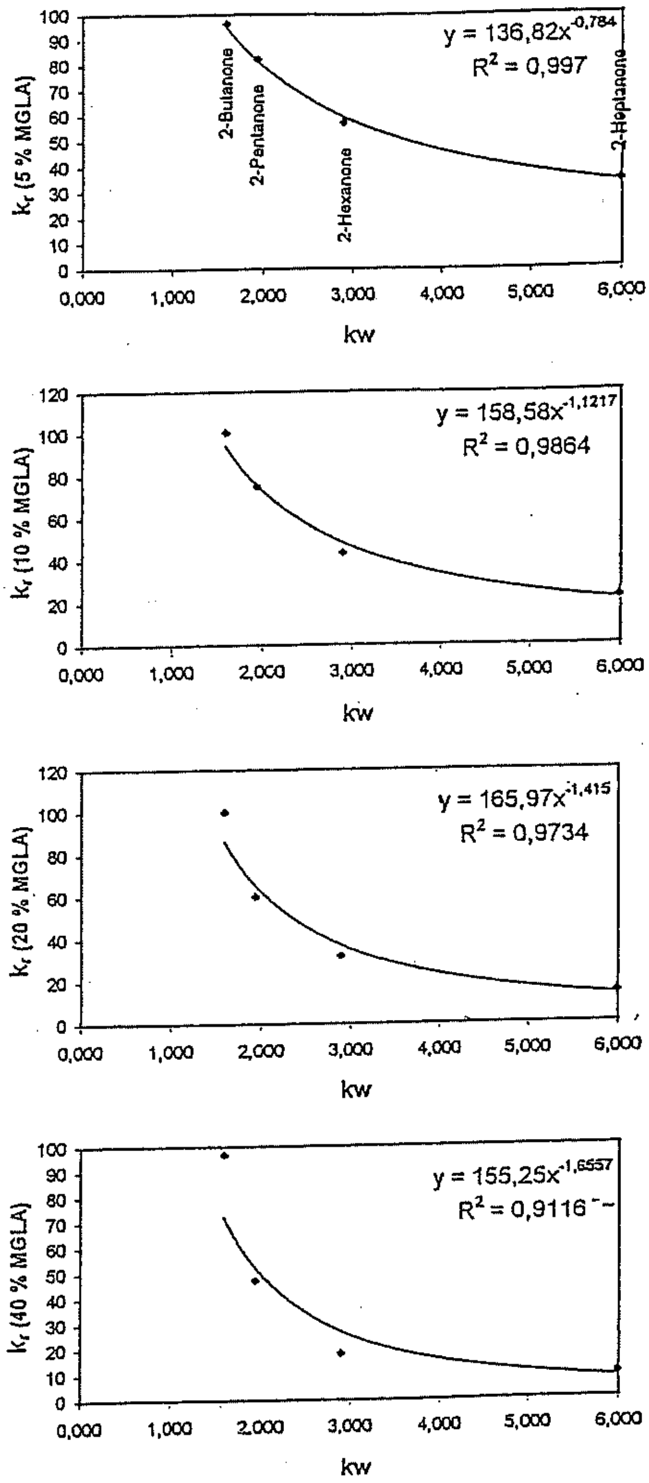

Figure 4. Relation between k_r and the capacity factor k_w.

As a conclusion, it appears that lipophilicity is the main factor which governs the air/liquid aroma distribution, even in low-fat systems. For all aroma compounds, the butter oil impact can be described by a correlation between retention ($1/k_r$) and lipophilicity.

LITERATURE CITED

Piraprez, G.; Hérent, M-F.; Collin, S. Flavour retention of lipids measured in a fresh cheese matrix, submitted, 1997a.

Piraprez, G.; Hérent, M-F.; Collin, S. The use of RP-HPLC capacity factors as lipophilicity index for aroma compounds. In Proceedings of the Cost action 96 *« Interactions of food matrix with small ligands influencing flavour and texture »*, 1997b.