

# Forschungskreis der Ernährungsindustrie e.V. (FEI)

## - Project Short Report -

AiF-FV 15217 N

„Investigations on effects of surface active components in concentrated lipophilic confectionery suspensions considering chocolate mass as example“

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<b>Industrial Association:</b>	Bundesverband der Dt. Süßwarenindustrie e.V., Bonn
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### **Aim of Research:**

Concentrated lipophilic suspensions, i.e. dispersed systems with a continuous lipophilic phase and dispersed solid particles like chocolate masses or chocolate coatings play an important role in the field of confectionery production. Due to the high solids volume fraction of up to 60%, behaviour of these suspensions is mainly determined by solids' properties like particle size distribution and surface properties. Mechanical refining of suspended solids, which has to be carried out due to sensory reasons, leads to particles' surface activation which also has an influence on suspension properties.

Surface active substances (SAS), so far mainly lecithin and polyglycerol-polyricinolat (PGPR), are added to influence interactions between refined solids among themselves and with the continuous lipophilic phase. The effect of different SAS with respect to solids surface covering and influence on suspension flow behaviour is still not known in detail. Therefore, selection and addition of SAS are often carried out empirically and have to be re-determined for each recipe depending on production parameters (e.g. refining). Additionally, new SAS like citric acid esters of mono- and diacylglycerol are discussed resp. tested for application in chocolate. So far, their effect in lipophilic systems is only investigated empirically compared to soy lecithin. Therefore, knowledge with respect to a physico-chemically based SAS-addition for a defined modification of surface properties in concentrated lipophilic suspensions like chocolate mass is still missing.

### **Research Results:**

At first, methods for determining concentration of selected SAS in a continuous lipophilic phase were developed and established as a basis for calculating solids surface covering with these SAS. Particularly, sugar ester analytics and visualisation of spatial phospholipid distribution on solids surfaces by CLSM were concerned.

Solids being involved in the investigations (glass spheres with modified surfaces as model systems, sugar, cocoa powder and milk powder) are characterised with respect to particle size distribution, surface energy and shape factors. In the frame of these analyses it was found that values of surface energy of all solids present in chocolate masses were comparable.

A general correlation between polar and dispersive parts of different solids' surface energies on one hand and surface covering with SAS on the other hand could not be found. An influence of solids surface morphology on fat immobilisation was detected. However, differences in fat immobilisation could not completely be attributed to differences in this parameter. The comparison of the effects of all SAS revealed that an increased surface covering with respective SAS resulted in a larger fat release from solids surfaces with PGPR as SAS being less effective than lecithin or citric acid ester.

The effect of SAS during mechanical refining of solids in the suspension depends on the type of solid as well as on the type of SAS. Particularly, PGPR addition before refining and conching showed a positive impact on suspensions flow behaviour. On the other hand, an addition after refining was more effective

concerning low yield stress and viscosity in the investigated suspensions for lecithin and citric acid ester as SAS. Separate addition of residual cocoa butter and lecithin during conching did not show a significant influence on fat immobilisation and resulting flow properties.

Solids covering with SAS affected flow properties of lipophilic suspensions via its influence on fat release. Lower fat immobilisation on solids surfaces reduced suspensions equilibrium viscosity independent of applied SAS. Regarding yield stress such an effect could not generally be measured. Analysis of spatial distribution of phospholipids on solids surfaces distinctly showed differences in the distribution uniformity. But, a longer duration of dry conching resulted in a more uniform phospholipid distribution on sugar particle surfaces corresponding to a reduction of suspension yield stress during conching.

### **Economical Importance:**

In Germany 430,000 t unfilled chocolate products presenting a value of approx. 1.9 billion € were produced in 2008. Additionally, approx. 200,000 t resp. 450 million € for chocolate coatings being used as semi-finished products for further processing have to be considered. More than 160 small and medium sized companies work in this field.

Investigations in the frame of the project which were also designed to save cocoa butter in these products via better control of flow properties are of important economic significance due to increased cocoa butter costs. Including SAS already being approved for application in chocolate production as well as SAS whose permission may be expected a successive transfer of results into industrial production will be enabled.

Particularly, results regarding the influence of the moment of SAS-addition during chocolate processing (refining), e.g. separate addition of lecithin and PGPR, may expand opportunities of chocolate producing companies with respect to influencing flow behaviour of chocolate masses. Additionally, results regarding the influence of dry conching duration on setting of required flow characteristics may be suitable to save costs of chocolate production by reducing energy consumption. Measuring methods being developed in the project also possess economic potential. Chemical analysis of sugar esters may be applied in production control. A further potential application represents the determination of phospholipid distribution on particle surfaces for an improved evaluation of conching processes.

### **Publications (selection)**

1. Franke, K.; Bindrich, U. (2009) Influence of solid particle surface properties on adsorption of surface active components in lipophilic suspensions (Poster), In: Fischer, P.; Pollard, M.; Windhab, E.J. (Eds.), Proceedings of the 5th International Symposium on Food Rheology and Structure, pp. 770-771, Zürich: Eidgenössische Technische Hochschule

### **lectures / posters (selection)**

1. Franke, K.; Bindrich, U. (2008) Emulsifiers in chocolate: New findings and their relevance for the industry, Köln: SchokoTechnik 2008 am 09.-11.12.2008, Vortrag
2. Franke, K.; Bindrich, U. (2009) Influence of solid particle surface properties on adsorption of surface active components in lipophilic suspensions, Zürich: 5th International Symposium on Food Rheology and Structure am 15.-18.6.2009, Poster
3. Strijowski, U.; Franke, K. (2009) Quantification of sugar esters in chocolate and oil samples, Dresden: HPLC 2009 am 28.6.-2.7.2009, Poster

### **Further Information:**

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