In many countries of Europe the mothers are increasingly reluctant to breastfeed and many babies are not exclusively nourished by breast-feeding. Consequently, a high percentage of mothers (circa 60%) use commercial infant food. As a result, the baby food market has grown significantly and with it, the assortment of products offered. Within the frame of a large programme initiated by CASCADE (Chemicals as contaminants in the food chain; Network of Excellence, FP6 funded consortium, targeting health risks in food), a specific integrated study on infant food was performed within the frame of a special work package project baby food which aim to integrate the knowledge and tools of a large number of partners in CASCADE. The main objective of the BABYFOOD project is to provide the European Union with basic information about the impact of commercial infant food on nuclear receptor based modulation. The focus is based on interpreting the scientific results with regard to nutritional advice and infant food quality.

Market baskets were designed for an “average European baby” and for babies of 4 selected countries in order to determine the geographical variability of the markets. The design of the baskets was based on elaborated monthly diets for EU babies that lack of breast feeding for the first 9 months of life fed with either milk, soy and hypoallergenic based infant formulae and weaned (at the 5th month) with industrial baby foods and beverages with products of identified brands on the basis of market shares based on 22 European countries (80% of the whole market, year 2007 was considered). These products, were weighted and pooled in an accredited laboratory generating 45 baskets to analyse and determine contaminants and nutrient levels as well as possible disruptive effects.

As a result, it was found that:

- The concentration level of the organochloropesticides, PCB and PCDD/F (WHO-TEQ) pg/g was negligible or relatively low in all investigated infant formulae and solid food samples.
- The calculated daily energy intake (kcal) recommended by all infant formulae suppliers is in tendency higher than the daily energy intake, recommended by the international organisations (WHO, 2006 and FAO, 2004) (Tab.1).
- Determination of Cd, Fe, Pb, Se, Hg, Cu, Ni, Zn, Ca, Mn manifest generally higher average level of all essential and non-essential elements in soy infant formula samples.
- High amounts of genistein were measured in soy infant formula samples. However, Iprodione, Procymidon and Vinclozolin were not detectable for all investigated samples.
- BPA and its chlorinated derivatives determined in infant formula samples exhibited no or low detectable amounts. However, a tendency to higher amounts is observed in solid food for the later studied infant months of feeding.
- Persistent organic pollutants such as DDE, PCB, and hexachlorobenzene were not detectable in infant formula and follow up formula but steadily increased to month 9 along the introduction of solid food items into the nutrition. (Fig. 1)
- E-screen assay using MCF7 BUS cells pointed out high estrogenic levels in soy formula based products.
Potential effects on thyroid signalling were evaluated using a cell based reporter assay and a Xenopus early embryo test. None of them revealed any thyroid hormone stimulating or inhibiting activity in the baby food extracts. Estrogen receptor activation and proliferational effects were monitored for baby food in the neuronal system using the murine clonal neuronal N2A cell line (neuroblastoma, intrinsic expressed ERα and β). In all infant food cohorts, soy based baby food induced the transcriptional estrogen receptor activity. Further on, we observe a cytotoxic impact of the hypoallergenic formula based samples compared to the control and other types of baby food on the treated cells.

Endocrine modulation responses in baby food matrices were identified using two human cell lines derived from tissues of the digestive system (HuH6: hepatoblastoma and DLD-1: colorectal adenocarcinoma). Both cell lines display qualitative and quantitative different nuclear receptors modulation intensities: in particular HuH6 seems more responsive to AhR modulation and DLD-1 to AhR and ERα. Infant formula matrices seem to evoke quantitative outcomes similar to the EDC used; however none of the matrices seem to have a comparable pattern to a particular EDC in both cell lines. This could imply a “matrix” effect.

Hypoallergenic based infant formula may modulate endocrine function of adult Leydig and adrenocortical cells affecting their response to trophic hormones and inhibiting the production of progesterone and estradiol, stimulated by FSH. Soy infant formula inhibited significantly the basal production of progesterone by rat granulosa cells and also the FSH-stimulated production of estradiol in the soy based formula for 5th month old babies. Hypoallergenic based formula for children of the same age inhibited LH stimulated production of estradiol.

The present study revealed that following the feeding recommendations of the manufacturers of infant formula may lead to an oversupply of energy based on nutritional components in the formula. The consequences of this finding are valid for more the 90 % of the infant formula brands present at the market in 2007 and may affect more than 80 % of European babies if they do not deny the complete ingestion of the food potentially offered to them. Interestingly independent of this study, WHO changed their recommendations for baby food with respect to lowering the energy contents and extending the period of breast feeding from 4 to 6 months.
months. Further, the baby food here analysed showed excellent quality with respect to the chemicals targeted. However, with respect to the modulation of some nuclear receptor responses some interesting differences between the different types of infant formulae were identified and will need further investigations about their potential impact to the growing child. The authors recommend repeating the study not only before changes in the baby food market take place, but also for clarifying and complementing some information gaps/open questions which occurred and additionally including pooled breast milk as a reference for comparative risk assessment strategies.

Acknowledgement
The author would like to express his appreciation for the financial support provided by the European Union network CASCADE (FOOD-CT-2003-506319) within the frame of WP19 projects (bread project and babyfood project)

Literature


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