1 Summary

1.1 Background

National representative dietary surveys among children and adolescents from the 1998-2001 revealed that one of the most important health-related problems in the diet of children and adolescents was a high intake of added sugar, and the major source of added sugar was soft drinks and 'saft' ('saft' is a fruit concentrate and shall be mixed with water before drinking).

In 2003, a WHO Technical report "Diet, Nutrition and Prevention of Chronic Diseases" concluded that sugar sweetened drinks probably increased the risk of overweight. The Norwegian Directorate for Health and Social Affairs (Sosial- og helsedirektoratet) recommends a reduction in consumption of sugar sweetened soft drinks. A higher consumption of soft drinks with intense sweeteners might be the result of such a recommendation. The consequences of a high intake of intense sweeteners and benzoic acid have to be explored as regards possible exceedances of the ADI.

The Norwegian Food Safety Authority requested the Norwegian Scientific Committee for Food Safety (VKM) to assess the relationship between consumption of sugared soft drinks, 'saft' and nectar and health challenges such as overweight, diabetes and dental health on one hand, and the potential public health risks of elevated intake of intense sweeteners and benzoic acid on the other. The level of benzoic acid might potentially be higher in soft drinks, 'saft' and nectar with intense sweeteners since sugar, which has a preservative effect, is removed. VKM was requested to evaluate exposure levels (current situation) from existing national dietary surveys and scenarios where it was assumed that 50% of the consumed soft drinks, 'saft' and nectar contain added sugar, and 50% contain intense sweeteners (the 50% scenario) and finally exposure levels where it was assumed that all of the consumed soft drinks, 'saft', and nectar contain intense sweeteners (the 100% scenario).

This report does not discuss other health problems beside overweight, diabetes and dental health which may be related to high consumption of sugared soft drinks, 'saft' and nectar, such as poor nutrient quality of the diet in relationship to coronary heart diseases and cancer.

1.2 Results and conclusions

Trends in the consumption of sugar, intense sweeteners, soft drinks and 'saft'
Both the food consumption surveys made by Statistics Norway from 1975 to 2004 and national representative dietary surveys conducted in the period 1993-2001 show that the consumption of added sugar and sugared soft drinks and 'saft' has increased over the last decades. According to sales figures for carbonated soft drinks after 2002 the consumption pattern seems to be changing as the sales of soda with intense sweeteners and water are increasing, while the sales of sugar sweetened soda are decreasing. The sales figures for carbonated soft drinks (both with sugar and intense sweeteners) also show a small decrease from 2002 to 2006. It remains to be seen whether this is an enduring trend, and if so, in what age groups these changes have occurred.

Effects of sugar/intense sweeteners from soft drinks/'saft' on overweight and diabetes
Five out of 9 prospective studies and 4 out of 4 intervention studies showed a positive association between high consumption of sugar sweetened soft drinks and weight gain/obesity. In conclusion, epidemiological and experimental evidence indicate that an increase in the consumption of sugar sweetened soft drinks is associated with weight gain and obesity. The majority of the

published studies on intense sweeteners and body weight indicate that intense sweeteners do not lead to an increase in the energy intake and body weight.

There are few studies on the association between consumption of sugar sweetened beverages and the risk of developing diabetes, especially diabetes type 1. The few prospective studies available indicate a positive correlation between sugar sweetened beverage consumption and the risk of developing diabetes type 2. However, this may result from the increased risk of weight gain and obesity observed with high consumption of sugar sweetened beverages, and may not necessarily be a direct effect of the sugar sweetened beverages.

The epidemiological data generating the background for the conclusions on health effects (overweight and diabetes) from soft drinks, all have their limitations including methodological aspects such as small sample sizes, short duration of follow-up, lack of repeated measures in dietary exposures and outcomes, and confounding by other dietary and lifestyle related factors. These limitations are discussed throughout the report. More studies on the association between soft drink consumption and overweight and diabetes are needed to confirm the conclusions. Especially research related to the consumption of sugar sweetened soft drinks and diabetes, both type 1 and type 2 is scarce.

Sugar/intense sweeteners from soft drinks, 'saft' and nectar and dental health
Sugar sweetened soft drinks, 'saft' and nectar can affect dental health in two ways: through dental caries and dental erosion. The association between sugar intake and dental caries is well documented and relatively linear. Individuals with good oral hygiene and regular fluoride exposure may tolerate higher levels of sugar intake before caries occurs. As there are no differences in pH and acid content between sugar sweetened soft drinks, 'saft' and nectar and the drinks with intense sweeteners, a reduction of the sugar content will not affect the incidence of dental erosion, but most probably reduce the incidence of caries. From a dental health aspect it is recommended to reduce the intake of acidic and sugar sweetened drinks.

Dietary surveys used in the exposure assessment
The dietary surveys used in the exposure assessments of soft drinks 'saft' and nectar and the intake estimates of added sugar, intense sweeteners and benzoic acid were conducted between 1997 and 2001, and may therefore not be fully representative for the current situation. In addition, no intake data for intense sweeteners from other sources than soft drinks, 'saft' and nectar were available for children.

Risk characterisation of intake of added sugar
The current intake estimations show that the mean percentage of energy (E%) deriving from added sugar is higher than recommended among Norwegian children and adolescents, while the intake among adults is around the maximum recommended level of 10E%. About 85% of the 4-, 9- and 13-year-olds had more energy from added sugar than 10E%. Among the 1- and 2-year-olds the proportions were 43% and 56%, respectively.

In the scenario where it is assumed that 50% of the consumed soft drinks, 'saft' and nectar contain intense sweeteners and the other half contains added sugar, the estimated mean percentage of energy from added sugar is below or close to 10E% among both 1- and 2-year-olds and adults. However, 76-84% of the older children (4- to13 years of age) still have an energy percentage from added sugar higher than 10E%.

In the scenario where it is assumed that 100% of the consumed soft drinks, 'saft' and nectar contain intense sweeteners, the mean percentage of energy from added sugar is estimated to be below or close to 10E% for all age groups. A change from the current level to the 100% scenario reduced considerably the percentage of children with E% from added sugar above the maximum recommended intake of 10E%. However, about 50% of the children aged 4- to13 years still have

an energy percentage from added sugar higher than 10E%, while the proportions among 1- and 2- year-olds are 25% and 17%, respectively.

Risk characterisation of intense sweeteners and benzoic acid
It was not reported any use of neohesperidin DC and thaumatin in soft drinks, 'saft' and nectar by the industry, and no risk assessment was performed for these intense sweeteners.

The estimated intakes of the intense sweeteners aspartame, saccharin and cyclamate from soft drinks, 'saft' and nectar were well below the acceptable daily intake (ADI) for all age groups both at the current level of intake and in the 50% and 100% scenarios. It was not possible to estimate the intake of sucralose because sucralose first was introduced to the Norwegian market in 2005. At the present use, it is anticipated that the intake of sucralose is well below ADI for all age groups. Altogether, no health concern is connected to the use of the above-mentioned intense sweeteners in soft drinks, 'saft' and nectar.

The estimated intake of acesulfame K among high consumers of soft drinks, 'saft' and nectar in the age group 1-year-old children at the current level, was close to ADI, while the intake for the other age groups was well below ADI. The intake of acesulfame K was also below ADI for all other age groups when shifting from the current level to the 100% scenario. The probability of exceeding ADI for acesulfame K increased in the 100% scenario for high consumers (95^{th} percentile) of the age groups 1- and 2-year-old children. This would represent an erosion of the safety margin for acesulfame K exposure, and the contribution from other food sources to the total intake of acesulfame K is not known.

At the current level, the estimated total intake of benzoic acid was close to ADI among high consumers (95^{th} percentile) of soft drinks, 'saft' and nectar in all groups except men, and above ADI among the high consumers among 1-year-old children. In the 100% scenario the total benzoic acid intake from food was above ADI among high consumers in all groups except men. Children (95^{th} percentile) from 1- to 4-years of age were found to have the highest intake of benzoic acid on a body weight basis. The estimated total benzoic acid intake from food does not include the intake of benzyl derivatives used as flavourings in food, and which are metabolised to benzoic acid in the body. In addition to the exposure from food, both adults and children might be exposed to a considerable amount of benzoic acid from cosmetics.

Adverse health effects of a high benzoic acid intake are anticipated to be of most concern for children. Benzoic acid is conjugated in the body with the amino acid glycine before excretion, and the glycine capacity might be exceeded during very high intakes of benzoic acid. This is mainly a concern for organisms in growth, such as children, where absence of glycine might lead to reduced weight gain. The capacity of glycine conjugation in children is not known. It is likely to be dependent on the nutritional status and intake of glycine. On average, Norwegian children have a sufficient intake of protein. The total benzoic acid exposure to children is not known, and the estimated high intake of benzoic acid from foods and drinks in 1- to 4-year-old children in Norway should therefore be of special concern.

1.3 Recommendations

The Norwegian Scientific Committee for Food Safety recommends:

- More up to date and detailed dietary surveys including brand-names should be performed in Norway for different age/population groups.

- More research on the association between added sugar and health is needed, especially regarding diabetes type 2.

- The estimated intake of acesulfame K approached ADI for small children and the contribution from other food sources than soft drinks, 'saft' and nectar is not known. VKM therefore recommends that the intake of acesulfame K for young children should be closely monitored in the future.

- The children from 1- to 4-years of age were found to have the highest estimated intakes of benzoic acid relative to their body weight, and their intakes exceeded the ADI. The contribution from benzyl derivates used as flavourings in food, and which are metabolised to benzoic acid in the body as well as exposure to benzoic acid from cosmetics are not included in the estimates. VKM therefore recommends that more detailed intake studies are performed where all sources of benzoic acid exposure is included.