Dietary fibres and Dairy products

– How does it affect the development of cancer and diabetes type 2

Kostfibrer och Mjölkprodukter- Hur påverkar det utvecklingen av cancer och diabetes typ 2

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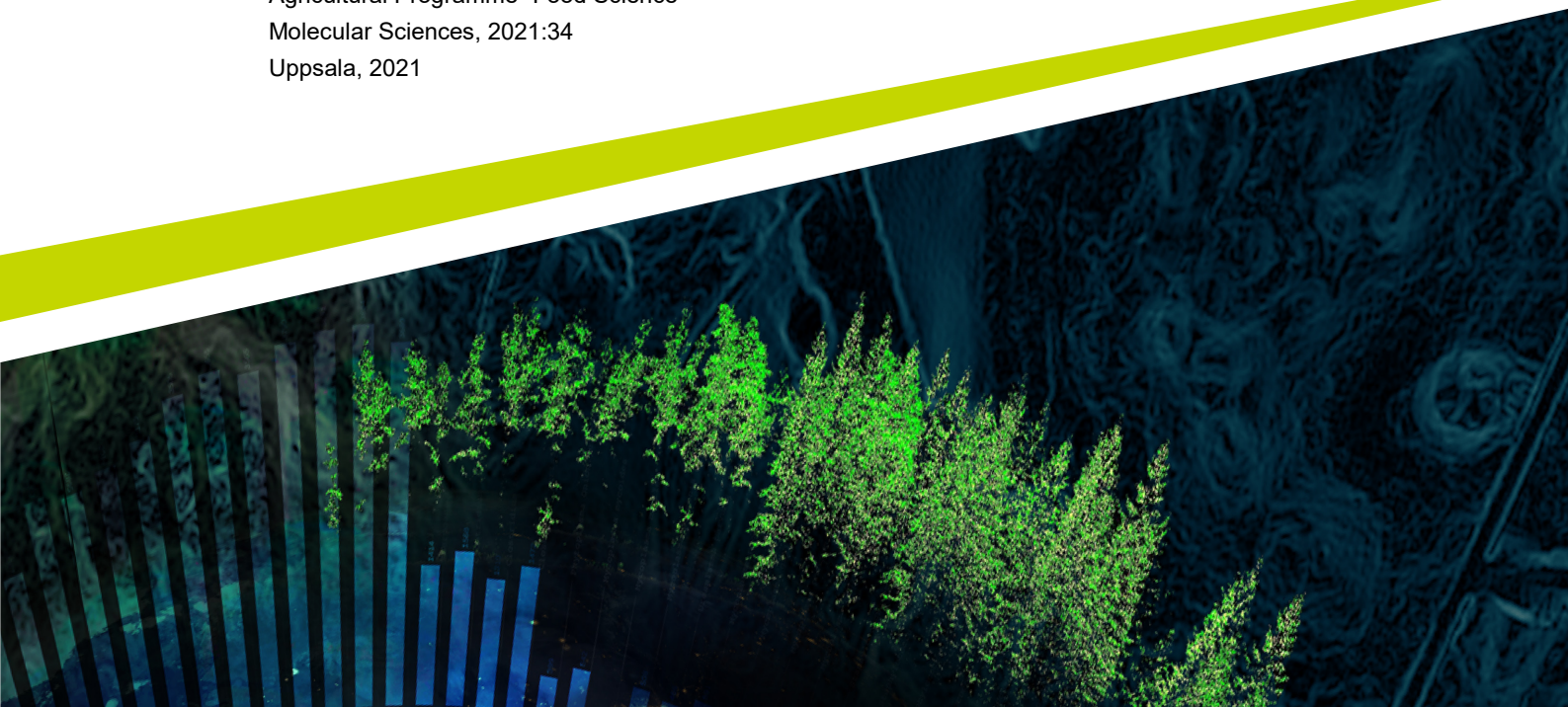

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Abstract

Eating habits are one of the main factors that can affect the development of non-communicable diseases such as cancer and diabetes. The prevention of cancer and diabetes is a significant public health challenge due to the growing rate all over the world. Dietary behaviours are one of the important factors to lower the risk of these diseases. This review aims to investigate if dairy products and dietary fibres consumption can affect the risk of developing cancer and diabetes and the recommended intake.

Dairy products are part of a balanced diet, supplying the human body with essential nutrients with high protein quality, vitamin, and minerals. Dietary fibre has an important role in the diet proposing to give beneficial effects for human health due to the fermentation in the colon, reduced gut transit time and increased faecal bulking. Dairy products and dietary fibres may influence insulin sensitivity and insulin resistance that could reduce the risk for diabetes type 2. Also, properties that can influence cell differentiation, cell proliferation and apoptosis that can affect the development of cancers.

The findings of this study suggests that dietary fibres can be protective against the risk of colorectal cancer and reducing the risk of diabetes type 2. But the results remain inconclusive whereas other studies are showing no associations between dietary fibres and the development of cancer and diabetes type 2. The recommended intake of dietary fibres was highly variable between the studies for lowering the risk of cancer. The recommended intake for diabetes type 2 were between 15-40g per day.

Dairy product consumption resulted in a possible decreased risk of colorectal cancer and a probable increased risk for prostate- and breast cancer. However, other studies showed no associations between cancer development and dairy product consumption. Yoghurt resulted to be the most protective dairy product against type 2 diabetes with a recommended intake between 50-200g per day. Though there were no associations between dairy product consumption and the risk of diabetes type 2, and the results remains inconclusive.

The inconsistent results may be due to there are other lifestyle factors that have an impact on the development of diabetes and cancer and therefore present different results.

Keywords: Dietary fibres, Dairy products, Cancer, Diabetes

Sammanfattning

Matvanor är en av de främsta riskfaktorerna som kan påverka utvecklingen av cancer och diabetes. Det växande sjukdomsantalet av cancer och diabetes i världen medför att förebyggandet har blivit en stor folkhälsoutmaning. Eftersom matvanor är en betydande faktor av utvecklingen för sjukdomar så är det viktigt förstå hur vissa livsmedel kan påverka dessa sjukdomar. Denna studie undersöker hur kostfibrer och mjölkprodukter kan påverka utvecklingen av cancer och diabetes typ 2.

Mjölkprodukter är en del av en välbalanserad kost och ger viktiga näringsämnen som protein, vitaminer och mineraler. Kostfibrer har länge funnits i kosten och antas ha fördelaktiga hälsoeffekter, fermentering av tarmfloran, förkortad passeringstid i tarmen och en ökad vätskebindande effekt. Mjölkprodukter och kostfibrer kan en inverkan på insulinkänsligheten och insulinresistensen, vilket kan påverka utvecklingen av diabetes typ 2. Samt andra egenskaper som cellförökningen, celldifferentiering och apoptos som kan ha en effekt på utvecklingen av cancer.

I denna studie påvisas det att kostfibrer kan ha en beskyddande effekt mot tjock- och ändtarmscancer och en minskad risk för utveckling av diabetes typ 2. Det rekommenderade intaget av kostfibrer visades sig variera väldigt mycket gällande risken för cancer. Medan minskad risk för diabetes typ 2 rekommenderades ett intag mellan 15-40g per dag. Resultaten är inkonsekventa gentemot andra studier som inte påvisar några samband mellan utvecklingen av cancer och diabetes typ 2. Mjölkprodukter resulterade i en minskad risk för tjock- och ändtarmscancer men en ökad risk för prostata- och bröstcancer. Dock är resultaten inkonsekventa då vissa studier påvisade inga samband mellan cancer och mjölkprodukter. Gällande diabetes typ 2 visades det ge en gynnsam effekt med konsumtion av mjölkprodukter, speciellt yoghurt som gav mest reducerande effekt mot diabetes typ 2 med ett rekommenderat intag av 50-200g per dag. Även här är resultaten motsägande då vissa resultat inte visar några samband mellan mjölkprodukter och diabetes typ 2.

Andra riskfaktorer än enbart matvanor har en stor påverkan på utvecklingen av livsstilssjukdomar och kan påverka resultaten.

Nyckelord: Kostfibrer, Mjölkprodukter, Cancer, Diabetes,

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Abbreviations

BCAA	Branched chain amino acid
BCFA	Branched chain fatty acid
CRC	Colorectal cancer
IGF-1	Insulin-like growth factor
LAB	Lactic acid bacteria
NSP	Non-starch polysaccharides
SHBG	Sex hormone binding globulin
SCFA	Short chain fatty acid
SFA	Saturated fatty acid
T2DM	Type 2 Diabetes mellitus
25-(OH)D	25-hydroxyvitamin D
$1,25(OH)_2D$	1,25-dihydroxycholecalciferol

1. Introduction

According to the World Cancer Research Fund there is an increase of non-communicable diseases like cancer and diabetes. Maintaining a healthy diet is one of the factors that can lower the risk of cancer and diabetes (World Cancer Research Fund/American Institute for Cancer Research, 2018a). In 2020, 19.3 million people were diagnosed with cancer and 10 million people died from cancer. A global rise of cancer is expected to rise with 47% from 2020 to 2040 (Sung et al., 2021). People diagnosed with diabetes type 2 are also rising globally, causing over 1 million deaths per year (Khan et al., 2020).

Whole grains, fruit and vegetables contributing to dietary fibres are recommended to consume to maintain a good health (World Cancer Research Fund/American Institute for Cancer Research, 2018a). Dairy products contribute to essential nutrients and are part of a balanced diet (Marangoni et al., 2019). Purpose of this essay is to investigate the associations between dietary fibres and dairy products to cancer and diabetes development and the recommended intake that are proposed to give an effect.

1.1. Aim

The aim of this study is to investigate if dietary fibers and dairy products will affect the risk of developing cancer and diabetes type 2. The study is focusing on some of the most common cancer forms that's been associated with eating habits. Diabetes type 2 has been giving attention in this study due to it is a diet-related disease.

The questions in this study are:

1. How does dietary fibres and dairy products affect the risk of developing cancer and diabetes type 2?
2. What is the recommended quantity if dietary fibres and dairy consumption gives a reducing effect on cancer and diabetes type 2?

1.2. Method

This essay was conducted by a systematic literature search on scientific journals using web databases such as *PubMed*, *Advances in nutrition*, *Science Direct* and *Medline*. The keywords that were used in different combinations are following: “Breast cancer”, “Calcium” “Cancer”, “Cheese”, “Colorectal Cancer”, “Dairy products”, “Diabetes”, “Diseases”, “Dietary fibre*”, “Gastric cancer”, “Glycaemic Index”, “Health”, “Insoluble”, “Milk”, “Prostate cancer”, “Soluble”, “T2D”, “Whole grains”.

2. Background

2.1. Dietary fibres

Carbohydrates are the main energy source for people worldwide, it consists of starch, sugars, and dietary fibres (Reynolds et al., 2019). Dietary fibres have been associated with health benefits such as faecal bulking, viscosity, and fermentation. Guidelines to consume food rich in dietary fibres are encouraged (Davison and Temple, 2018). Fruits, vegetable, cereals, legumes, and whole grains are naturally sources containing rich in fibres (Reynolds et al., 2019).

2.1.1. Definition

Dietary fibres are defined by the European commission as carbohydrate polymers with three or more monomeric units and cannot be digested or absorbed in the human intestine (EFSA Panel on Dietetic Products, 2010). The definition of dietary fibres can differentiate between countries. The degree of polymerisation is up to each national authority to decide whether carbohydrate polymers with 3-9 monomeric units shall be classified as dietary fibres. But there is a universal agreement that dietary fibre is resistant to hydrolysis and do not have the ability to absorb in the small intestine and therefore enters the colon unmodified. The study of dietary fibres can be complicated because the definition varies between countries. Also, dietary fibre contains complex groups of substances that results in different physiological properties (Fuller et al., 2016).

2.1.2. Classification

According to EFSA (2010), non-digestible carbohydrates and lignin are defined as dietary fibres. That includes non-starch polysaccharides (NSP), resistant oligosaccharides, resistant starch, and lignin. The variety in size and shape is highly variable in the different polymers. Due to the different structural variability in fibres, it results in different chemical and physiochemical properties. Therefore, fibres can be categorized into two different fibres, soluble and insoluble. The classification depends on the solubility of the fibres in hot water (EFSA Panel on Dietetic Products, 2010).

NSP are the main component of dietary fibres, having cellulose, hemicellulose, pectins and hydrocolloids as the main classes. NSP contain both insoluble and soluble fibres. Cellulose is categorised as insoluble, and pectin and hydrocolloids are categorised as soluble fibres. Hemicellulose can contain both soluble and insoluble fibres. Resistant starch contains only insoluble fibres and resistant oligosaccharides are soluble (EFSA Panel on Dietetic Products, 2010).

Soluble fibres

The soluble fibres are well fermented in the colon, resulting in growth of beneficial bacteria in the intestine and produces short chain fatty acids (SCFA) (Dai and Chau, 2017). Due to their branched structure, it makes them more likely to be soluble in water (Capuano, 2017). Soluble fibres can be subdivided into viscous and non-viscous groups. Resistant oligosaccharides are soluble but do not have any viscous properties (EFSA Panel on Dietetic Products, 2010). While pectins, ß-glucan, guar and psyllium are included as viscous soluble fibres. Having a greater viscosity and gel forming capacity it slows down the gastric emptying and increases the absorption of nutrients in the intestinal walls, reducing the glucose absorption. Soluble fibres affect the glucose and insulin responses (Fuller et al., 2016).

Insoluble fibres

Insoluble fibres are non-viscous fibres that are poorly or partially fermented in the colon. Its insolubility in water increases the stool bulk by being able to hold the water in the fibre matrix, also having an ability to bind carcinogens (Kunzmann et al., 2015). The fibres reduce the intestinal transit time which lowers the risk of interaction of faecal mutagens in the colon (Dai and Chau, 2017; World Cancer Research Fund/American Institute for Cancer Research, 2017). Insoluble fibres are mostly components from the cell wall. Lignin, cellulose, and some hemicelluloses are some of the examples (Dai and Chau, 2017). Insoluble fibres may reduce the insulin resistance that will possibly lead to a reduced risk of diabetes type 2 (Weickert and Pfeiffer, 2018).

2.1.3. Food containing fibers

The main sources of dietary fibers are whole grain, cereals, pulses, fruits, vegetable, potatoes, nuts and seeds (EFSA Panel on Dietetic Products, 2010). Fibers can be categorized depending on their originated food source, like fruit fiber and cereal fiber. Fruits and vegetables contain mainly the soluble viscous fiber pectin. Pectin can also be present in legumes and nuts. Cereals contains both soluble and insoluble fibers, such as cellulose and hemicellulose that are present in the cell wall in plants. Cereals like oat and barley contain high amounts of the soluble fiber ß-glucan. Legume and pulses contain resistant starch that are classified as insoluble (Fuller et al., 2016).

Whole grains are the edible parts of the grain, that includes the endosperm, the germ, and the bran. Dietary fibres exist in all the different parts but varies in quantity. Proteins, lipids, carbohydrates, minerals, vitamins, and phytochemicals are other components in whole grains. Whole grains come from cultivated cereals and the main types are rice, wheat, and maize. The proposed health properties from cereals are mainly from the whole grain and recommends to consume to improve the health (Tullio et al., 2020). The benefits from consumption of whole grain are considered due to its dietary fibres content but also containing other substances like magnesium and phytochemicals that are implied to have a protective effect on type 2 diabetes and have anticarcinogenic properties (Davison and Temple, 2018; O'Keefe, 2016). Scientific evidence has shown that whole grains and dietary fibre are probable associated with a decreasing risk of colorectal cancer (World Cancer Research Fund/American Institute for Cancer Research, 2018b).

2.2. Dairy products

The demand for dairy products is growing as the global population grows. Dairy products have been suggested to have both positive and negative impacts on human health. They are seen as a nutrient rich food source that contains good sources of protein, vitamins, and minerals (Grout et al., 2020). Dairy products are a main source for calcium in countries where the consumption is high (World Cancer Research Fund/American Institute for Cancer Research, 2018c). Negative effect from dairy products have been raised as a concern to human health. The high content of saturated fatty acids and naturally occurring hormones have been discussed with a increasing risk of diabetes and cancer with higher consumption (Grout et al., 2020). There is a wide variety in different products categorised into dairy products such as whole milk, low fat milk, cheese, butter, fermented milk, yoghurt, and cream. The composition of nutrients and shape in the different products are highly diverse.

2.2.1. Composition

Milk is composed of 87% water, 3-4% fat, 3,5% protein, 5% lactose and 1,2% minerals. Whole milk contains more than 3.5% fat, semi-skimmed milk contains 1,5%-1,8% fat and skimmed milk have less then 0,5% fat content. 60% of the fat content in milk is saturated fatty acids (SFA). The proteins in milk are caseins and whey and contains all the essential amino acids for the human body. Calcium and phosphorous are the major minerals in milk next to potassium, magnesium, zinc, selenium and the vitamins B, A and E (Marangoni et al., 2019).

Proteins

Casein and whey differentiate from other animal proteins. It contains higher levels of branched chained amino acids (BCAA), insulinogenic amino acids, minerals and bioactive properties (Comerford and Pasin, 2016). BCAA are leucine, isoleucine, and valine, who are able to increase the hormone insulin-like growth factor 1 (IGF-1). Leucine activates pathways that promote cell replication and inhibits cell apoptosis (Willett and Ludwig, 2020). Milk proteins are suggested to have the ability to stimulate insulin and regulate the glycaemic index, which are beneficial for people with type 2 diabetes (Comerford and Pasin, 2016). By contrast it is suggested to be linked to a higher risk of cancer, especially prostate and breast cancers due to the possible increased levels of IGF-1 from consuming dairy products (Willett and Ludwig, 2020).

Dairy fat

Dairy fat consists about 60% of saturated fatty acids with high diversity in composition (Marangoni et al., 2019), for instance short- and medium chain fatty acids, conjugated linoleic acids, odd-chain saturated fatty acids and branched-chain fatty acids (BCFA). Some of the fatty acids have beneficial effects on human health by functioning as bioactive molecules. BCFA have been suggested being able to increase the insulin sensitivity, inhibit cell proliferation and increase apoptosis (Taormina et al., 2020). Although, high animal fat intake may affect the risk of developing prostate cancer by increasing levels of IGF-1 and cell proliferation whereas a low-fat diet has been proposed to slow down tumour growth (Lin et al., 2019).

2.3. Health effects on fibers and dairy products

2.3.1. Dietary fibers

Dietary fibres are considered to have physiological health benefits by decreasing the intestinal transit time, increasing the stool bulk and production of short chain fatty acids (SCFA) through fermentation by the gut microflora. The microflora in the colon ferments the dietary fibres, depending on type of fibre it differentiates how well the fibres can be fermented. Insoluble fibres are less fermented comparing to soluble fibres and contributes instead to the faecal bulking by their ability of binding water. Even the well fermented fibres contribute to the faecal bulking by resulting in an increased microbial mass (EFSA Panel on Dietetic Products, 2010). Dietary fibre may induce protection of cancer by having anti-inflammatory properties, reduce levels of IGF-1, improve insulin sensitivity, and decrease the

oestrogen and androgens concentrations by potentially upregulating the levels of SHBG (Deschasaux et al., 2014, 2013).

Fermentation of dietary fibres

In the human intestine there is a large composition of different bacterial species that ferment fibres. It results in a production of SCFA that are important fuel for the human gut microbiota. The mainly SCFA that are produced by dietary fibres are acetate, propionate, and butyrate. The concentration of acetate, propionate and butyrate differentiates depending on the type of fibre being fermented. Depending on their chemical structure soluble fibres ferments to a greater degree than insoluble. Insoluble fibres like cellulose and lignin are poorly fermented by the gut microbiota (Capuano, 2017).

2.3.2. Dairy products

The components from dairy products can be potentially beneficial to human health. Fermented products, like cheese and yoghurt are commonly made through lactic acid fermentation (Guo et al., 2019) which are proposed to protect against colorectal cancer. Other substances like calcium, SCFA and vitamin D in dairy have also shown to be protective against colorectal cancer (World Cancer Research Fund/American Institute for Cancer Research, 2018c).

Calcium, Vitamin D and Vitamin K

The content of calcium in milk can have potential mechanisms that correlates with human health, especially protection against colorectal cancer. A probability is that calcium binds to bile acids and fatty acids, which leads to a reduced cell proliferation and a stimulation on apoptosis in the colorectal epithelium, protecting the colon cells (Thorning et al., 2016). Lactose and casein in milk helps to increase the calcium bioavailability (World Cancer Research Fund/American Institute for Cancer Research, 2018c).

Dairy contains naturally small amount of vitamin D but fortification of vitamin D in milk products are common. Vitamin D and calcium are suggested to affect the insulin secretion. Vitamin D includes the vitamins D2 and D3 that are converted to 25-hydroxyvitamin D (25(OH)D), and thereafter converted to the active form 1,25-dihydroxycholecalciferol (1,25(OH)2D). Vitamin D regulates the calcium channels for insulin secretion in beta cells which means that deficiency of vitamin D will affect the insulin secretion. Calcium is an essential substance needed for normal insulin secretion due to the calcium channels in beta cells. Low levels of 25(OH)D may be associated with a higher risk of T2DM. 1,25(OH)2D stimulates receptors that leads to a stimulation of insulin sensitivity (Muñoz-Garach et al., 2019). Vitamin D are therefore suggested to suppress glycaemia by several mechanisms

such as increased insulin secretion, increased insulin sensitivity and a protection of beta cells apoptosis which will result in a lower risk of developing T2DM (Poppitt, 2020). It has been implied that $1,25(OH)_2D$ can inhibit cell proliferation and cell differentiation. Which could decrease the risk of developing certain cancers (colorectal- and prostate cancer). Also there has been indications that high calcium levels reduce the levels of $1,25(OH)_2D$ and that could result in a higher risk of developing cancer (Giovannucci, 2005).

Vitamin K_2 have a probable effect on T2DM by reducing the insulin resistance. Also, it has shown to lower inflammations that leads to an improvement of insulin sensitivity. Vitamin K_2 derives from bacterial cultures and therefore fermented dairy products, like cheese and yoghurt are rich in vitamin K_2 (Beulens et al., 2010).

2.3.3. Short-chain fatty acids

SCFA have been shown to have various health benefits. Propionate increases the glucose tolerance while butyrate has anti-carcinogenic and anti-inflammatory effects (Capuano, 2017). Butyrate is seen as the most important member in SCFAs family, suppressing the growth of colorectal cancer cells and therefore it may protect against colorectal cancer (Yang and Yu, 2018). Propionate and butyrate are implied to be involved in the activation of the intestinal gluconeogenesis and therefore improve the insulin sensitivity (Gowd et al., 2019). Acetate and propionate are absorbed by the colon and work as an energy source to the human body (EFSA Panel on Dietetic Products, 2010). SCFA decreases the pH of the colonic content that improves the absorption of minerals, lower the production of toxic metabolites, and inhibit pathogen growth (Capuano, 2017).

Fermented milk such as yoghurt and cheese are products that may require starter cultures such as lactic acid bacteria (LAB). LAB results in an increasing level of SCFA production (Poppitt, 2020), vitamin D bioavailability and reduce inflammations (Nilsson et al., 2020).

2.4. Recommended intake of fibers and dairy

Dairy products are an important food source for many countries, especially in the Nordic countries where it is a part in the food culture. The recommendation of dairy intake varies depending on country. In Sweden dairy products are recommended to eat 200-500ml per day to provide with enough calcium (Livsmedelsverket, 2021). The recommended intake of dietary fibres for adults are 25-35g per day. But normally consumption of dietary fibres is 20g per day (Livsmedelsverket, 2020).

2.5. Cancer and Diabetes

2.5.1. Cancer

Cancer is one of the leading causes of death in the world. Environmental and lifestyle behaviours are factors that can develop cancer. According to World Cancer Research Fund (2018), a healthy lifestyle might prevent the risk of cancer such as physical activity, healthy eating behaviours and maintaining a healthy weight. Whole grains, vegetables, fruits and beans are recommended to consume as a protection against colorectal cancer (World Cancer Research Fund/American Institute for Cancer Research, 2018a).

Colorectal cancer

Colorectal cancer (CRC) is the third most common diagnosed cancer incidence for both sexes and second for mortality. Incidence of colorectal cancer increases in countries uniformly where the human development index is increasing (Sung et al., 2021). Development of CRC are suggested to be caused by the reduced consumption of fibre rich foods that will lead to dysbiosis in the gut microbiota (O'Keefe, 2016). There is a probable evidence that dietary fibres and dairy products decreases the risk of CRC (World Cancer Research Fund/American Institute for Cancer Research, 2017).

Prostate- and Breast cancer

Prostate cancer is the second most common cancer incidence for men and breast cancer the most common diagnosed and leading cancer death in women (Sung et al., 2021). Some mechanisms that have been suggested to be involved in the development of prostate- and breast cancer are chronic inflammations (that stimulates carcinogenesis), higher IGF-1 levels, lower SHBG levels and high concentrations of oestrogens and androgens. Dietary fibre may induce protection of prostate- and breast cancer by having anti-inflammatory properties, reduces the levels of IGF-1, improve the insulin sensitivity, and decrease the oestrogen and androgens concentrations (Deschasaux et al., 2014, 2013). There is some proposed evidence that consuming dairy products increases the risk of prostate- and breast cancer by the increased levels of calcium and IGF-1 (World Cancer Research Fund/American Institute for Cancer Research, 2018d).

2.5.2. Diabetes Mellitus 1 and 2

Diabetes mellitus (DM) is a chronic metabolic disease that can be classified into two types. Diabetes mellitus type 1 is a result of insufficient insulin secretion and diabetes mellitus type 2 (T2DM) is caused by insulin resistance (IR). Which means that insulin has an inability to affect properly at a given concentration. Diabetes

mellitus can be developed of both genetic and environmental factors (Gowd et al., 2019). T2DM is a growing public health issue and has been linked to lifestyle factors such as dietary behaviours. There are some possible suggestions that dairy products have an effect on reduced risk of T2DM (Gao et al., 2013). In this study diabetes type 2 have been focused on between the association of dietary fibres and dairy products due to its probable affect on dietary behaviours.

2.5.3. Hormones

Hormones play an essential role in the human body, responsible for growth and reproduction. Hormones from dairy milk may have a cause on some physiological responses to human health. Evidence suggests hormones from milk have an impact on increased risks of certain cancer. Prolactin, oestrogen, progesterone, corticoids, androgens, prostaglandins, and insulin-like growth factor are the most natural hormones in milk (Malekinejad & Rezabakhsh 2015). There is some suggestion that Insulin-like growth factor, progesterone and oestrogen may increase the risk of cancer due to promoting cell proliferation and inhibiting apoptosis (Liao et al., 2020).

Insulin-Like Growth Factor

Insulin-like growth factor 1 (IGF-1) is a hormone from the IGF-family that stimulates cell growth, apoptosis and cell differentiation (Ventura, 2020). IGF-1 plays an important role in the glucose metabolism (Malekinejad & Rezabakhsh 2015). IGF-1 can circulate free or be bounded to IGF-binding proteins (Ventura, 2020). It has been associated that circulating IGF-1 have an anti-apoptosis effect and stimulate cell proliferation which can promote the growth of tumours (Malekinejad & Rezabakhsh 2015). Dietary fibre may reduce the IGFs bioactivity by increasing insulin-like growth factor binding protein 3 resulting in lower levels of free IGF-1 (Deschasaux et al., 2013). Associations between milk intake and high levels of IGF-1 have been discussed to have an effect on cancer development (Ventura, 2020).

Steroid Hormones and Sex hormone binding globulin

High levels of circulating oestrogen, androgen, and low levels of sex-hormone-binding globulin (SHBG) may partly be explained by an increased risk of breast and prostate cancer (Deschasaux et al., 2014, 2013). 60-80% of all oestrogen comes from the intake of dairy products in the western diet (Malekinejad & Rezabakhsh 2015). Dietary fibres may potentially reduce the levels of circulating steroids by increasing the concentrations of SHBG (Deschasaux et al., 2014, 2013).

3. Results and Discussion

3.1. Dietary fibres and the affect on cancer and diabetes

This study aimed to investigate if there is an association between the consumption of dietary fibers and the effect of developing cancer or diabetes. Also, the recommended intake for dietary fibers and dairy products that may reduce the risk of developing cancer and diabetes type 2.

3.1.1. Cancer

The three major health benefits from dietary fibres are viscosity, bulking and fermentation (Gowd et al., 2019). Different types of fibres have been suggested to be more or less effective to reduce the development of certain cancers.

Colorectal cancer

Total dietary fibres and fibres from cereal grains and fruits have been linked to potentially lower the risk of CRC (Kunzmann et al., 2015; Oh et al., 2019). Also, there is evidence that total dietary fibres probably reduce the risk of CRC (Reynolds et al., 2019; World Cancer Research Fund/American Institute for Cancer Research, 2017). Similar results were found in whole grain intake and a probable reason could be that whole grains have high fibre content and contains other substances that could function as protection of CRC (Reynolds et al., 2019; Tullio et al., 2020). Cereal fibres and fruit fibres were observed to reduce CRC risk, containing both soluble and insoluble fibres. An assumption could be that a combination of soluble and insoluble would give a beneficial effect on reducing the risk of CRC. This supports the observation from total dietary fibre having a protective effect. The results remain inconclusive where some studies observed either a probably limited evidence or no association between dietary fibre and colorectal cancer (He et al., 2019; World Cancer Research Fund/American Institute for Cancer Research, 2017).

Dietary fibres have antiproliferative effects due to the soluble fibres ability to easily get fermented. The insoluble fibres effect on stool bulking and reducing transit time lowers the risk for faecal mutagens interacting with the colon. Dietary fibres ability to lower the insulin resistance have also a protective effect against CRC. (World Cancer Research Fund/American Institute for Cancer Research, 2017).

The threshold of fibre intake to protect against CRC are in various proportions. One study observed a reduced risk of CRC with a daily fibre intake of 25-29g (Reynolds et al., 2019). Whereas another study found a lower risk of colorectal cancer with a median increase intake of cereal and grain fiber with 5.4 or more g/ 1000kcal and 3.8g or more g/1000kcal with intake of fruit fibers (Kunzmann et al., 2015). One study presented that more than 5g/d of fruit fiber were not seen to have a further reduction in risk of colorectal cancer and 10g/d of cereal/grain fibers were shown to give a decreased risk and would give a further reducing effect with a higher intake (Oh et al., 2019). Whilst one study did not find any difference between control group and testing group consuming 32g fibre per day and pointed out that the intake was too low to give any results and recommended a fiber intake of more than 50g per day (O'Keefe, 2016). The high various recommendations may be due to what kind of fibre that was consumed, and the definition of dietary fiber may vary between the studies. Also, the composition of the overall diet and other lifestyle factors that may affect the results.

Prostate and breast cancer

Total dietary fibers, insoluble and legume fibers were observed to be inversely associated with risk of developing prostate cancer. While soluble, cereal, fruit and vegetable fibers gave no association (Deschasaux et al., 2014). The results are inconclusive when some studies found no association between dietary fibre and prostate cancer (Egeberg et al., 2011; Wang et al., 2015) while other studies observed an inverse association (Deschasaux et al., 2014).

Vegetable fibers, containing a combination of insoluble and soluble fibers, and whole grains may have a protective effect on breast cancer (Deschasaux et al., 2013; Gaesser, 2020). In contrary total dietary fiber consumption have been proposed with no association of breast cancer (Deschasaux et al., 2013). The results are variable depending on type of fiber.

A possible mechanism for the reduced risk of prostate- and breast cancer by dietary fibre consumption may be due to the upregulation of SHBG levels, lowering circulating oestrogen and the reducing IGF-1 levels. Legume fibres and vegetable fibres containing components of insoluble fibres, that are more prone to reduce the transit time in the intestine and increase the faecal mass that may result in a reduction of carcinogenesis.

Soluble fibres, Insoluble fibres, and Whole grains

The different physiochemical properties from soluble and insoluble fibres may affect how they are associated with certain cancers. The soluble fibres may result in more anti-carcinogenic and anti-inflammatory properties due to the fermentation, resulting in SCFA. Insoluble fibres reduce the transit time in the intestine and may reduce the risk of faecal mutagens to interact with the intestine. Whole grains have been implied be protective against cancer (Gaesser, 2020; Tullio et al., 2020). The likely reason could be that whole grains contains more micronutrients and bioactive compounds that may prevent cancer, such as phytochemicals and magnesium that have anticarcinogenic properties. Another factor of whole grains potentially protection could be it contains both soluble and insoluble fibers which give different protective effects against cancer.

3.1.2. Diabetes

Dietary fibre intake has been observed to be associated with a reduced risk of diabetes type 2. Insoluble fibres, cereal fibre and whole grains have been found to give the most reducing effect (Weickert and Pfeiffer, 2018; Yao et al., 2014). While other studies observed weak or no associations between fruit fibres and vegetable fibres (Gowd et al., 2019; Wu et al., 2020). The findings suggest that fruit- and vegetable fibre containing mainly soluble fibres have less effect on insulin resistance and T2DM (Gowd et al., 2019). A likely explanation might be that insoluble fibres affect the reduction of insulin resistance. While soluble fibre slows down the absorption of nutrients which lowers the glucose response it should be more seen as a beneficial effect for controlling the glycemia for people with T2DM and not protect against the development of T2DM.

The evidence that cereal fibres and whole grains might have a more protective effect on reducing the risk of T2DM could depend on that it contains a larger amount of insoluble fibre. Also, cereal fibres may come from whole grains whereas a possible factor that other substances from whole grains could affect the reducing risk of T2DM. The recommended intake to observe a reduced risk of T2DM was between 15-40g of dietary fibres per day (EFSA Panel on Dietetic Products, 2010; Reynolds et al., 2020; Weickert and Pfeiffer, 2018; Yao et al., 2014).

3.2. Dairy products and the affect on cancer and diabetes

This part of the study aimed to investigate if there is an association between the consumption of dairy products and the effect of cancer and diabetes. Dairy products contain a complex composition of different nutrients which makes it a good nutrient rich food product. Due to the high complexity of nutrients makes it also difficult to distinguish which components are responsible for the development of different diseases.

3.2.1. Cancer

Dairy products could be a potentially factor for increasing the risk of breast- and prostate cancer but has also been inversely associated for other cancers such as colorectal cancer (Grout et al., 2020). The health benefits from dairy products are proposed to be from fermented dairy products due to the content of lactic acid bacteria and SCFA (Nilsson et al., 2020).

Colorectal cancer

There are inconsistent results for different dairy products and their effect on colorectal cancer. Several reports have shown that dairy products may be inversely associated with a reduced colorectal cancer risk. The findings suggest that calcium and vitamin D levels reduces cell proliferation, differentiation and stimulate apoptosis. Lactic acid bacteria and SCFA from fermented products may play an important protective role against CRC (Godos et al., 2020; Um et al., 2019; World Cancer Research Fund/American Institute for Cancer Research, 2018c).

Prostate cancer

Higher whole milk consumption has been associated with an increased risk of prostate cancer. A modest positive association were presented with 2% fat milk and prostate cancer (Lu et al., 2016; Preble et al., 2019). Whereas in another study no evidence of an increased risk was found in whole milk and fatal prostate cancer, instead an increased association was found with low-fat milk, milk, cheese, and total dairy (Aune et al., 2015). On contrary there were also findings of no association between total dairy products and increased prostate cancer risk (Preble et al., 2019). There are suggestions that high-fat intake may promote prostate cancer and could explain the results from whole milk and the increased risk of prostate cancer. Hence, the results from low-fat milk and the association of higher prostate cancer risk do not support the suggestion of high-fat intake promotes prostate cancer risk. Dairy fat has a complex set up of different fatty acids, and some of them having beneficial effect on human health, such as BCFA. The complexity of fatty acids in dairy products may influence the results from the studies.

An increase in IGF-levels and a suppression of $1,25(OH)_2D$ due to high calcium levels from milk have been associated with an probable elevated factor of prostate cancer. (Harrison et al., 2017; Willett and Ludwig, 2020; World Cancer Research Fund/American Institute for Cancer Research, 2018c). Due to its possible increased levels of IGF-1 from milk it may be a potential factor for the development of prostate cancer (Harrison et al., 2017). It can be suggested that dairy products can affect the risk of developing prostate cancer. But inconsistency is shown in studies with different dairy products. The amount of dairy product intake and the rate of severeness of prostate cancer can differentiate in the studies which may affect the results.

Breast cancer

Dairy products were associated with a lower risk of breast cancer with limited evidence (World Cancer Research Fund/American Institute for Cancer Research, 2018c). High intake of cheese products was observed to have a modest decreasing effect on breast cancer, but was also shown to have no association to cancer overall (Nilsson et al., 2020; World Cancer Research Fund/American Institute for Cancer Research, 2018c). On the other hand, studies have shown a relation between higher levels of IGF-1 and a increasing risk of breast cancer (Willett and Ludwig, 2020).

The most significant finding was the inverse association with CRC and dairy products, but the specific dairy product is still controversial. An increased risk of prostate and breast cancer were suggested in some studies while other studies presented that dairy product resulted in no association of cancer overall.

3.2.2. Diabetes

Dairy product consumption and the effect of developing diabetes have shown mixed results, suggesting having favorable or neutral benefits against T2DM. Findings from several studies showed a decreased inverse association in relation with low-fat milk, low-fat dairy, cheese, and yoghurt while others showed no significant results between dairy products and T2DM (Alvarez-Bueno et al., 2019; Drouin-Chartier et al., 2016; Gao et al., 2013; Guo et al., 2019). The potential mechanism reducing the risk of T2DM could be due to the high calcium levels, vitamin D and milk protein content that has been proposed to influence the insulin sensitivity. One suggestion to the different results could depend on lifestyle choices, people who consume more low-fat dairy products are more prone to live a healthier lifestyle which could reduce the risk of developing T2DM.

Fermented dairy products, like yoghurt and cheese have been given mixed results. Yoghurt are suggested to be strongest correlated with a reduced risk of T2DM and cheese to be moderate or neutral associated toward T2DM risk (Alvarez-Bueno et

al., 2019; Guo et al., 2019; Poppitt, 2020). Both cheese and yogurt are fermented products that contains SCFA, LAB, calcium, vitamin K and proteins (whey and casein) who all have a reducing effect on insulin resistance. A possible explanation why yoghurt have a more significant reducing effect than cheese could be due to the differences in their fat content. There were some suggestions that saturated fat in high fat dairy products may reduce beneficial effects from other nutrients and also reducing the insulin sensitivity (Aune et al., 2013; Gao et al., 2013). On the other hand, cheese have shown to have a decreasing risk of T2DM in comparison to whole milk, and cheese contains higher amount of fat then whole milk. A probable explanation on cheese being more beneficial against T2DM development could be due to it is a fermented product that contains a higher amount of vitamin K then whole milk and reduces the insulin resistance (Gao et al., 2013).

The recommended intake for total dairy products that may give beneficial effects against diabetes type 2 are 200-400g per day. Were cheese intake of 30-50g per day and yoghurt was suggested to 50-200g per day to have a reducing effect (Aune et al., 2013; Gao et al., 2013).

4. Conclusion

The purpose of this study was to determine if dietary fibres can influence the development of cancer and diabetes. Total dietary fibre, cereal- and fruit fibres have shown to give the most protection against colorectal cancer, still the findings are inconclusive whereas some studies found no association between dietary fibres and colorectal cancer. For other site-specific cancers, the results were inconclusive. Taken together, these results suggest that dietary fibre may have an inversely association or no association on the development of cancers. Between dietary fibre and diabetes type 2 it was found to have an inverse association between insoluble fibres, cereal fibres, and whole grains. Other types of fibre resulted in no or weak associations with a decreasing risk of T2DM. The recommended intake for improving the possible health benefits for cancer are highly variable depending on type of fibre and studies. The recommended intake for lowering the risk of T2DM were between 15-40g per day. Also, it is important to state that people who eat more fibre may be more prone to have a healthier lifestyle. Being more physical active and maintaining a healthy weight could contribute lowering the risk of T2DM.

The second aim of this study was to investigate if dairy products influence the development of cancer and diabetes. Dairy products may be associated with a decreased risk of colorectal cancer. An increased risk for prostate and breast cancer were presented in some studies, but the results remain vague due to other studies found no associations. The results are inconclusive between cancer development and dairy product consumption. Dairy products were shown to either have favourable associations or no associations between the development of type 2 diabetes. Yoghurt may have the strongest effect of reducing the risk of type 2 diabetes with a recommended intake between 50-200g/day.

The limitation of this study is the broad variety in dairy products in composition and nutrients. Also, the diversity in dietary fibres definition and their composition in studies makes is difficult to summarize an equal conclusion. Many food sources containing dietary fibres are usually containing both soluble and insoluble fibre in varying amounts, which makes it difficult to obtain similar results. In addition, the large quantity variations in the studies may be a significant factor for the different results. Perhaps some amounts were not enough for alteration and therefore give inconclusive results. Other lifestyle and genetic factors are also significant for the

development of cancer and diabetes and should be considered when establishing these results.

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