Is there a need for "healthy" chocolate? Systematic literature review

¿Es necesario el chocolate "saludable"? Revisión sistemática de la literatura

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Abstract. Background: Chocolate has special properties that help to protect the human body against cardiovascular diseases; it increases HDL cholesterol and decrease blood pressure. Chocolate consumption also helps to reduce stress, elevates mood and reduces tiredness. The purpose of this review is to identify, select, organize and summarize studies that investigate chocolate in relation to health, sensory characteristics and people's attitudes. This report is part of the master thesis: Is there a need for "healthy" chocolate? Systematic literature review and consumer research in Belgium and in Denmark, submitted by the author in June 2015 at Aalborg University in Copenhagen. Methods: This study presents three areas related to chocolate: Chocolate and its relation to health, Chocolate sensory characteristics and acceptance, and attitudes towards Chocolate. A systematic literature review has been done to identify, select, organize and summarize studies that investigate chocolate in relation to these three areas. Four databases were chosen: PubMed, Science Direct, Scopus and Web of Science because of their extension and because they overlay cross disciplinary researches. Results: A total of 2062 hits were obtained in the four databases. In total sixty articles met the criteria and were identified as relevant. The articles were classified according to the three areas included in the study. In relation to health, it has been stated in many studies that polyphenols in chocolate can improve health, especially cardiovascular diseases related. Regarding sensory characteristics and acceptance of chocolate, it has been said that chocolate shape has an influence on chocolate perception. Polyphenols cause astringency and bitterness to chocolate making it not too appetizing for consumers; however for health reasons, polyphenols should be kept. Concerning the attitudes towards chocolate, there are many factors that lead to chocolate craving. Chocolate is the most craved food item in North America. It influences people's mood and create a satiety feeling. Conclusion: Based on this review it can be concluded that a "healthy" chocolate could be part of a healthy diet. People like to indulge in chocolate, women more than men. The literature supports the health properties that chocolate consumption has, for instance, it is necessary to work on chocolate product development.

Keywords. attitudes, chocolate, health, sensory characteristics.

Resumen. Antecedentes: El chocolate tiene propiedades especiales que ayudan a proteger el cuerpo humano de enfermedades cardiovasculares, incrementa el colesterol HDL y reduce la presión sanguínea. El consumo de chocolate también ayuda a reducir el estrés, eleva el ánimo y reduce el cansancio. El propósito de esta revisión es identificar, seleccionar, organizar y resumir estudios que investiguen el chocolate en relación con la salud, las características sensoriales y las actitudes de las personas. Este artículo es parte de la tesis de maestría: Is there a need for "healthy" chocolate? Systematic literature review and consumer research in Belgium and in Denmark (Es necesario el chocolate "saludable"? Revisión sistemática de la literatura y estudio al consumidor en Bélgica y Dinamarca), presentada por la autora en Junio del 2015 a la Universidad de Aalborg en Copenhague. Métodos: Este estudio presenta tres áreas relacionadas con el chocolate: Chocolate y su relación con la salud; características sensoriales y aceptación del chocolate; y actitudes hacia el chocolate. Una revisión sistemática de la literatura fue realizada para identificar, seleccionar, organizar y resumir estudios que investiguen al chocolate en relación con estas tres áreas. Cuatro bases de datos fueron escogidas: PubMed, Science Direct, Scopus y Web of Science por sus extensiones y porque superponen investigaciones interdisciplinarias.

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Resultados: Se obtuvieron un total de 2062 hits en las cuatro bases de datos. Un total de sesenta artículos cumplieron los criterios y fueron identificados como relevantes. Los artículos fueron clasificados de acuerdo a las tres áreas incluidas en el estudio. En relación a la salud, se ha indicado en muchos estudios que los polifenoles en el chocolate pueden mejorar la salud, especialmente en enfermedades cardiovasculares. De acuerdo a las características sensoriales y aceptación del chocolate, se ha dicho que la forma del chocolate tiene una influencia en la percepción del mismo. Los polifenoles causan astringencia y amargor al chocolate, haciéndolo no muy apetecido para los consumidores; sin embargo, por razones de salud, los polifenoles deben ser conservados. Acerca de las actitudes hacia el chocolate, hay muchos factores que llevan al deseo incontrolable de consumir chocolate. El chocolate es el alimento más apetecido en Norte América, éste influencia el estado anímico y crea una sensación de saciedad. Conclusión: Con base en esta revisión se puede concluir que un chocolate "saludable" puede ser parte de una dieta saludable, a la gente le gusta disfrutar del chocolate, mujeres más que hombres. La literatura respalda las propiedades saludables que tiene el consumo del chocolate, por esto es necesario trabajar en el desarrollo de productos de chocolate.

Palabras claves. actitudes, chocolate, salud, características sensoriales.

1. Background

Nowadays there is a prevalence of overweight and obesity in the whole world causing health problems, especially in the cardiovascular system. Chocolate has special properties that help to protect human body against cardiovascular diseases; for example, it increases HDL cholesterol and decrease blood pressure. Chocolate consumption also helps to reduce stress, elevates mood and reduces tiredness. The purpose of this review is to identify, select, organize and summarize studies that investigate chocolate in relation to health, sensory characteristics and people's attitudes.

2. Methods

A systematic literature review has been done to identify, select, organize and summarize studies that investigate chocolate in relation to health, sensory characteristics and people's attitudes. Four databases were chosen: PubMed, Science Direct, Scopus and Web of Science because of their extension and because they overlay cross disciplinary researches.

2.1 Search strategy

To identify the relevant studies, keywords were established. The group of words and the combinations used in the four databases are stated in Table 1. As an important factor, the search was directed solely for articles published from 2004 to 2014.

Table 1. Keywords used for the search in the databases

Common terms	Health related	Sensory characteristics related	Attitudes related
Chocolate	Health	"Sensory characteristics"	Attitude
Cacao	Macronutrients	Taste	Perception
"Theobroma cacao"	Nutrition	Liking	Influence
Adults	Diet	Preference	Emotion *
			Mood
			Sentiment*
			Reaction
			Passion
			Feeling*
			Pleasure
			Guilt
			Satisfaction
			Sensation
			Excitement

* Word could have other ending (plural).

The common terms that were used for the search were "Adults" and "Chocolate". "Adults" because they are the chosen target group and "chocolate" for being the main topic of this research. Besides "chocolate", the terms "Cacao" and "Theobroma cacao" were used as synonyms. In each of the three areas a combinations of words were used.

The combinations of words that were used in each of the database are the following:

- Combination 1: Chocolate OR cacao OR Theobroma cacao AND adults AND health OR macronutrients OR nutrition OR diet.
- Combination 2: Chocolate OR cacao OR Theobroma cacao AND adults AND sensory characteristics OR taste OR liking OR preference.
- Combination 3: Chocolate OR cacao OR Theobroma cacao AND adults AND feeling* OR pleasure OR guilt OR satisfaction OR sensation OR excitement OR emotion* OR mood OR sentiment* OR reaction OR passion OR attitude OR perception OR influence.

The numbers of hits were collected in a table in order to keep track of the search.

2.2 Inclusion criteria

The criteria to keep the articles were established together with the supervisor of the thesis. All the articles should present in their studies the following criteria:

- Chocolate / cacao related information
- Healthy people
- Adults
- A health, sensory characteristics and acceptance or attitudes and beliefs outcome
- Enough sample power
- English as the report language
- Only academic research

2.3 Screening articles

The purpose of the articles screening is to distinguish the obtained hits in order to have a clear and quality outcome. The steps were followed based on the instructions in the books: "Doing your literature Review Traditional and Systematic Techniques" [1] and "Systematic Approaches to a successful literature review" [2]. The articles were screened following the next steps:

1. Titles examination: From all the hits, two persons read each title together and decided if the article was relevant or not.
2. Abstracts examination: From the titles that were kept, the abstracts were read. This time the two persons read individually each one of the abstracts. To evaluate the study, the article should follow more than one of the following criteria: The aim should be clearly stated, the sample size should be calculated, a standardized outcome measurement should be used, proper statistical analysis needed to be applied and/or the study should not show major limitations.
3. Entire text examination: From the remaining abstracts, the full text was read. Two persons divided the total number of articles into two. In a period of two weeks the articles were read and then exchanged.
4. Summary tables: After all articles were read, the summary tables were elaborated. These tables contain the key points of the articles: Title, author(s), year of publication, aim of the study, country where it was conducted, methods, sample size, and age of the sample. Besides this, the tables included the outcome of the study, differentiated by one on the areas which the study was designed: Outcome 1 health, outcome 2 sensory characteristics, outcome 3 attitudes. The two readers worked in half of the articles while the other worked in the other half. Each one of the readers marked already the article as if it should be included or excluded from the study and the reason for this consideration.
5. Final tables: The tables were exchanged and the two readers checked the other half of the articles together with the tables. It was necessary to check if all the details were on the tables and the other person's point of view related with the inclusion or exclusion criteria. If there were differences between the resolutions whether the articles should be or should not be included in the review, the readers had to argue and eventually agree about the final decision.

2.4 Synthesis of articles

A narrative synthesis has been used to summarize the results and synthesizes the evidence found in the articles. It will tell the story of what has been found in relation to chocolate and the three studied areas.

3. Results

The results of this systematic literature review will show the key points presented in scientific articles about the determinants for eating chocolate among adults. A total of 2062 hits were obtained in the four databases. Figure 1 shows the study selection process.

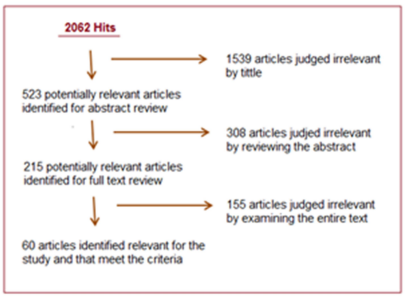

Figure 1. Flowchart of the study selection process - Inspired by [3].

In total sixty articles met the criteria and were identified as relevant. The articles were classified according to the three areas studied: Health, Sensory Characteristics and Acceptance and Attitudes towards chocolate.

3.1 Studies in relation to Health and Chocolate

"Although chocolate is considered typically as a food people should indulge in only occasionally, several short-term experimental studies suggest that chocolate, already in amounts of several grams per day, improves endothelial and platelet function, and reduces blood pressure and markers of inflammation. Flavanols in cocoa are thought to be responsible for these effects" [4].

One of the most cited ideas in the articles regarding chocolate in relation to health, is the effect that polyphenols contained in chocolate, has on people's health. Sarriá et al. [5] states that content of polyphenols in chocolate, especially flavanols have a potential to improve health, but the effects that chocolate might have like acting as antioxidant, anti-inflammatory can vary from person to person and it always depends on the person's health and diet. It is also important to differentiate that polyphenols content in chocolate can vary from cacao to a processed product (chocolate), since during the manufacturing process the polyphenol content can decrease [6].

3.2 Studies in relation to Sensory characteristics and Acceptance of Chocolate

"Our most surprising result was that proportionally, more men than women reported a desire to consume more chocolate despite having significantly lower chocolate craving and liking scores" [7].

The articles related to sensory characteristics and acceptance showed different outcomes. Some of the main findings are these: According to Lenfant et al. [8] shape has an influence on chocolates' characteristics perception like cocoa, caramel, aftertaste and texture. Chocolate shapes are also usually associated to a certain type of chocolate and melting speed. Milk chocolate is usually associated to round shapes while dark chocolate is associated with angular shapes [9]. Melting and air

circulation in mouth plays an important role in chocolate aroma release and its flavour perception.

Methylxanthines may have an influence on chocolate liking, especially in dark chocolate [10]. In order to produce a dark chocolate product, especially when the cocoa is from a single origin, it is relevant to know the target market preferences [11]. Something else to take into account is that polyphenols provide astringency and bitterness to chocolate and this does not fulfill consumer expectations [12] but there is a health interest in preserving polyphenols content in chocolates.

3.3 Studies in relation to Attitudes towards Chocolate

"Craving for chocolate is not hunger dependent, nor easily satisfied by other foods or substances. Eating chocolate can boost positive mood states, but these mood improving qualities of chocolate are likely to be short-lived and may be accompanied by simultaneous increases in negative effect particularly guilt. Feeling of guilt and ambivalence about chocolate consumptions may arise because the attractive sensory appeal of chocolate must be weighed against its potentially unhealthy nutritional properties (e.g., high fat and sugar content), and the stigma associated with unrestrained overindulgence of chocolate" [13].

Chocolate is the most craved food item. In North America, chocolate craving is significantly common among women when comparing to other countries. It has been seen that these are usually related to eating disorders, especially among women [14]. In one of the studies it has been reported that one of the most important reasons for craving chocolate is liking or satisfaction [15] but, there are also some cultural, psychosocial and physiological factors that might lead to this [14]. Chocolate craving has been considered harmless in comparison to cigarettes, alcohol and drugs; however this is leading to increase food consumption thus, obesity particularly among women [16]. It has also been seen that chocolate might influence people's mood. Chocolate is the food item that is usually craved when a depressive mood is present [17]. Macht & Mueller [18] also stated that a small amount of chocolate has an influence on improving negative mood just after its consumption and this might be due the chocolate's palatability. It has also been found that dark chocolate trigger a satiety feeling more than milk chocolate does and for instance lower the future energy intake. It has also been proved that dark chocolate reduces appetite for sweet snacks [19].

4. Conclusions

The purpose of this review was to identify, select, organize and summarize studies that investigate chocolate in relation to health, sensory characteristics and people's attitudes. It has been found that chocolate has a positive effect on human health. Chocolate has special properties that help to protect human body against cardiovascular diseases; it increases HDL cholesterol and decrease blood pressure. Chocolate consumption also helps to reduce stress, elevates mood and reduces tiredness. However, some people after eating chocolate, feel guilty or have a negative attitude. It has also been found that chocolate is the most craved food in the world, especially among women.

Based on this review it can be concluded that a "healthy" chocolate could be part of a healthy diet. People like to indulge in chocolate, women more than men. The literature supports the health properties that chocolate consumption has, for instance, it is necessary to work on chocolate product development.

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