FORTIFICATION OF CHOCOLATE: A REVIEW

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Abstract

Today world is facing health related problems, which is due to either obesity and scarcity. To overcome these problems world is focusing on the nutritious lifestyle. Fortification is the one of the ways to overcome this problem, fortification is the technique of improving the nutrition value of the food by adding certain supplement, this method is able to revolutionise the food industries. Fortification of nutrition is a good way to introduce fortified food in the market as it is demanded worldwide, and consumed by people of all ages, so it can be used as a nutrient supplement and will help to overcome the health problems and could help to overcome the scarcity of the nutrients in the simplest way possible. In this paper we are going to discuss about certain fortified chocolate products containing certain added nutrients which can revolutionise the chocolate industry. This will help to overcome scarcity of nutrients in the body, and will serve its part in healthy life, without compromising flavours of chocolate.

Keywords: fortification, nutrition, chocolate supplement, scarcity.

Introduction:

Chocolate is one of the most consumed food product in the world because of its unique flavour, taste and aroma, chocolate is made up of the key ingredient known as cocoa powder or cocoa butter. The cocoa powder is made up of the cocoa beans which are bitter in the taste; it has to be fermented to release its flavours, cacao the plant from which cocoa beans is harvested.

Chocolate has certain fascinating properties, consumption of the chocolate releases feel good hormone which is serotonin and dopamine, which supresses' anxiety and stress. Other than hormones chocolate also has the nutritional qualities, it is rich in minerals, such as **iron**, magnesium, and zinc. The cocoa contains antioxidants called flavonoids, which have several health benefits. Cacao plant has high levels of minerals and antioxidants. It is effective against the Cardio-metabolic Disorder and Type-2 diabetes.

Fortifying the chocolate with nutrient supplement increases the certain nutrients content in chocolate resulting in healthier and more nutritious chocolate product, this fortification will provide essential nutrient to the consumers, without compromising unique characters of the chocolate such as, aroma, flavour and the taste.

Literature review and related work

Nurfitri Ekantari, et al 2019[1], conducted experiment to determine the stability of milk and dark chocolate fortified nanocapsule carotenoids of Spirulina platensis. The chocolate formula base was designed by community industry of chocolate bar in Kulon Progo, Yogyakarta. Two types of chocolate (milk and dark) are fortified with nanocapsules carotenoid of Spirulina. The composition of chocolate paste: cocoa butter is 27.5:25 (milk) and 58:24,5 (dark), nanocapsule was added amount 0.372%. Fortified and control product were tested on 80 untrained panelists. The results showed that fortified chocolate did not show differences in aroma, taste, and texture with control. The dominant profile of aroma and chocolate flavor between fortified products and controls in the milk or dark chocolate was detected similar components but the intensity is slightly different. Fortified chocolate with nanocapsules spirulina showed the flat bloom development was lower than control. They also tested the shelf life of the chocolate and turn out that dark chocolate has a shelf life 1.5 times longer than milk chocolate.

Roberta Tolve, et al 2018[2], these authors have conducted experiment in which they fortified the chocolate with the microencapsulated phytosterols (MP)to reduce cholesterol in the individual. They prepared samples containing 64, 72 and 85 % of the cocoa fortified with 0, 5, 10 and 15% MP. Sensory evaluation demonstrated a positive effect on the acceptability of the functional chocolate, resulting in stable cholesterol reducing product.

Khaled M. Al-Marazeeq; 2018[3], conducted the experiment to evaluate proximate composition and sensory attributes of Dark Chocolate fortified with Wheat Germ, he prepared dark chocolate fortified with 10% of Wheat germ and analysed it where he found out that the protein and mineral contents in the chocolate increased significantly, fat contents were reduced, while moisture and carbohydrate were similar. The sensory evaluation of the dark chocolate fortified with Wheat Germ found out to be moderate as compared to the Dark Chocolate.

Lucia Godočiková1, EvaIvanišová, Miroslava Kačániová; 2017[4], have conducted the experiment to fortify the chocolate with Sea Buckthorn and Mulberry to assess improvement of antioxidant level in the dark chocolate. They have used techniques to analyse nutrients contents, for evaluation of total polyphenolic content we used Folin-Ciocalteu reagent, for total content of flavonoids spectrophotometric assay based on a formation of coloured flavonoid-aluminium complex.

Dace Pastore, Sandra Muizniece-Brasava, 2016[5], These authors have conducted experiment to fortify chocolate to increase its iron concentration. This experiment is conducted as the children, woman of reproductive age and sports

person don't get iron in proper amount. To overcome this problem, they fortified the chocolate with iron. They used Bovine Alimentary Albumin as the source of Iron. Comparing fortified products with non-fortified control samples of chocolate snacks the iron content increased from (1.17 – 2.61) to (10.15 − 11.53) mg 100 g-1 in products supplemented with bovine alimentary albumin. Indicating higher no. of iron in fortified chocolate.

L. L. Dean, C. M. Klevorn, B. J. Hess; 2016[6], have conducted experiment to add flavonols from peanut skin into the chocolate. The use of phenolic compounds extracted from peanut skins as antioxidant source for the fortification of milk chocolate. Consumer liking of milk chocolate enhanced by adding sub threshold (0.8 % (w/w)) inclusion levels of encapsulated peanut skin extract was found to be at parity with milk chocolate as a control.

Madhavi Baskaran and Rita Narayanan; 2016[7], have conducted experiment to fortify the chocolate with omega 3. they used alpha linolenic acid (ALA oil) from flax seed as a source of omega 3. The thermal behavior of cocoa butter and omega 3 oil blends were analyzed by differential scanning calorimetry. Solid state of fat in each blend (SFC) steadily decreased when the blend was subjected to rising temperatures of 5 to 35°C. Highly significant difference ($P < 0.01$) was observed between SFC content of each blend at varying temperature gradients. The microstructure study using Polarised Light Microscope revealed that crystal size of omega 3 oils was found to exhibit increasing trend with an increase in the inclusion level of ALA oils. It was determined that 5% and 10% inclusion levels were identified to be suitable for chocolate making.

Mine Gültekin-Özgüven, et al 2016[8], have worked on Fortification of dark chocolate with spray dried black mulberry waste extract encapsulated in chitosan-coated liposomes. For this, by using high pressure homogenisation at 25,000psi fine-disperse
anionic liposomes of black mulberry (Morus nigra) extract (BME) were prepared.

K. Haritha, L. Kalyani and A. Lakshmana Rao; 2014[9], have conducted the experiment to analyse the health benefits of the chocolate. Upon analysing the nutrients and other contents of chocolate they found out that chocolate have significant amount of flavonols and antioxidents and could help to prevent Cardiovascular Diseases as well as Type-2 Diabeties. It also improves endothelial functions and vascular functions.

Table No. 1: Different types of chocolate fortifications.

S.N.	Research Paper Title	Name Of Author	Remark
1.	Fortification Of Dark Chocolate With Microencapsulated Phytosterols.	Nurfitri Ekantari, Siti Ari Budhiyanti, Wahdan Fitriya, Asep Bayu Hamdan and Ciacia Riaty;	Reported, to determine the stability of milk and dark chocolate fortified Nano-capsule carotenoids of Spirulina platensis. They used ratio chocolate paste: cocoa butter is 27.5:25 (milk) and 58:24,5 (dark), Nano capsule was added amount 0.372%. The fortified chocolate showed low flat bloom in chocolate and also found out that the dark chocolate have shelf life 1.5 times more than the dark chocolate.
2.	Omega 3 Fatty Acid Fortified Functional Chocolate	Madhavi Baskaran and Rita Narayanan;	Observed, chocolate fortified with alpha linolenic acid (ALA oil) from flax seed. The chocolate enriched with omega 3, which can eliminate the problem of the unavailability of the omega 3.
3.	Evaluation Of Proximate Composition And Sensory Attributes Of Dark Chocolate Fortified With The Wheat Germ.	Khaled M. Al-Marazeeq	Reported, to fortify dark chocolate with the wheat germ, where he found out that 10% Wheat Germ in chocolate is the best. Upon proximate analysis the results were as follows, • Fat - Reduced • Protein - Incresed • Minerals - Incresed • Carbohydrate - Similar • Moisture - Similar
4.	The Influence of Fortification Of Dark Chocolate.	Lucia Godočiková, Eva Ivanišová, Miroslava Kačániová	Observed that, to fortify the chocolate with Sea Buckthorn and Mulberry to assess improvement of antioxidant level in the dark

			chocolate efficiently. Chocolate fortified with mulberry exhibits more amount of polyphenols and antioxidant capacity than that of plane chocolate.
5.	Fortified Chocolate Snacks With Increased Level Of Iron	Dace Pastore, Sandra Muizniece-Brasava	Reported, Fortified chocolate with iron, to produce iron rich food to overcome iron deficiency. They used the Bovile Alimentary Albumin as the source of the Iron and fortified chocolate with it. The concentration they used was 4% of total product.
6.	Minimizing The Negative Flavor Attributes And Evaluating Consumer Acceptance Of Chocolate Fortified With Peanut Skin Extracts	L. L. Dean, C. M. Klevorn, B. J. Hess;	Studied, to produce milk chocolate which have the similar antioxidant properties and flavonols level equal to the dark chocolate. For this purpose they used the peanut skin as the source of the flavonols. They found out that 0.9 % (w/w) of peanut skin threshold is best to make the falavonols levels of milk chocolate same to the dark chocolate.
7.	Fortification Of Dark Chocolare With Phytosterols : Chemical And Sensory Evaluation	Roberta Tolve, Nicola Condelli, Marisa Carmela Caruso, Diego Barletta, Fabio Favati and Fernanda Galgano;	Observed to add flavonoids from peanut skin into the chocolate phenolic compounds extracted from peanut skins is use as a novel antioxidant source for the enrichment of milk chocolate.
8.	Fortification Of Dark Chocolate With Spray Dried Black Mulberry Waste Extract Encapsulated In Chitosan-Coated Liposomes And	Mine Gültekin-Özgüven, Ayse Karadag, Seyma Duman , Burak Özkal, Beraat Özçelik,	Worked on Fortification of dark chocolate with spray dried black mulberry waste extract encapsulated in chitosan-coated liposomes, to increase shelf life of the chocolate.

	Bioaccessability Studies.		
9.	Health Benefits Of Chocolate	K. Haritha, L. Kalyani and A. Lakshmana Rao	Reported, after analyse the nutrient composition of chocolate and concluded the benefits of the chocolate to body and also found out that chocolate is helpful to prevent cardiovascular diseases as well as the Type-2 Diabetes.

Conclusion

Fortification is the process of adding nutrients into foodstuff that doesn't present in it. The goal of fortification is to help people remedy their nutritional deficiencies. The chocolate which we reviewed are the perfect example of vastness of fortification. Fortification of the chocolate was being done for different reasons to increase all over nutrient concentration, addition of specific nutrient and increase shelf life.

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