

Folate is one of the essential water soluble vitamins (vitamin B9) for growth and development in foetuses. Folic acid is the synthetic form of folate, typically used for supplementation and food fortification, whereas folate is found naturally in fruit, vegetables and grain. Folate is a co-factor for enzymes. When consumed, both folic acid and folate are reduced to the substrate tetrahydrofolate, the biologically active form of folic acid. This is necessary to form methyl-tetrahydrofolate, an essential component for nucleotide synthesis. However up to 50 – 80% of naturally occurring folate is lost after cooking, while folic acid is much more stable.

Folate plays an active role in DNA and RNA synthesis, as our body replicates genetic material through DNA replication. This means that sufficient folate is required for cell division (mitosis, meiosis). RNA synthesis is a significant factor of protein production, necessary for metabolic processes involving enzyme activity. Rapid multiplication of cells requires an increased amount of folate in the blood, for example, for the production of red blood cells and the development of the foetus during pregnancy. The deficiency of folate decreases the amount of oxygen red blood cells carry to other cells, resulting in megaloblastic anaemia. A deficiency may also result in the infant developing neural tube defects (NTD). This happens when the neural tube of the foetus does not close when it should, 3 to 4 weeks after conception. Depending on where the defect is located along the backbone, the defect is most commonly *spina bifida*, which results in nerve damage that causes lower body paralysis. Such defects may also result in anencephaly, where much of the brain of the infant has not formed. These babies will die shortly after birth.

All these conditions have negative consequences for the child, as of the 64% at babies with NTD's born alive, 100% of babies with anencephaly will die within the month, and 90% of babies with spina bifida will have severe thoracic or lumbar lesions. Those with a thoracic lesion have a life expectancy of 40 years, and a low quality of life.

The ample consumption of folic acid around 4 weeks prior to conception, optimally around 400mcg per day, has been proven to reduce neural tube defect incidence by 70%. It is recommended that women who plan to become pregnant should have an extra 400 mcg a day on top of the already recommended 400mcg. This is because a high level of folate will allow effective cell proliferation as the embryo develops.

Fortification is the addition of one or more essential nutrients in a food, whether or not it is normally contained in the food for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups. There has been speculation on the role of folate in decreasing the occurrence cardiovascular disease and strokes. In conjunction with vitamins B6 and B12, folate has been proven to regulate the levels of homocysteine in blood, an amino acid independently linked to cardiovascular disease. It is still unclear as to whether low homocysteine levels will result in fewer occurrences of these diseases, but they have notably declined in both USA and Canada immediately after mandatory fortification of flour. However, there are large concerns about the increased intake of folate in masking B12 deficiency, a problem that affects a considerable proportion of our elderly population.

Socially, mandatory fortification will result in families being saved the emotional strife of having a child with a NTD. They will be able to live without having the costs, care and difficulty involved with their child's well-being. It will also save the potentially affected children from a lifetime disability, allowing them to experience life as a normal citizen rather than spending up to months in hospital. However, this is at the sacrifice of consumer choice to the population. As the biological implications of fortification are also not completely certain, mandating it to the population is ethically questionable.

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There is a strong conflict of opinion concerning the announced fortification of folic acid in bread in New Zealand. The main group against the legislation includes the NZ Bakers Association, NZ Food & Grocery Council, Organics NZ and the Green Party. These groups argue that they value consumer choice and that each individual has a right to choose their own nutritional diets. In a 2005 NZ Food Safety survey, 84% of New Zealanders were opposed to the mandatory fortification. The NZ Food & Grocery Council believes fortification would not result in significant further reduction as the incidence of NTDs has already decreased during the past 20 years, a claim that has been backed some scientists also opposing the idea (Tim Green, Jim Mann, 2003).

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The main groups advocating the mandatory fortification include the NZ Paediatric Society, most scientists, the Labour party and families affected by NTDs. Rosemary Marks states that such a deferral will result in "perhaps up to 20 preventable NTD pregnancies per year in NZ and up to 15 preventable terminations." (Paediatric Society, 2009). However, scientists like Murray Skeaff (Otago University) and Joanne Dixon (Clinical Geneticist of Wellington Hospital) advocate fortification, arguing that scientific research shows that folate fortification is safe for the whole population. Such as the opposition, however, these opinions would be spurred by a bias.

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After analysing the research and opposing opinions, I believe that the benefits of folic acid fortification outweigh the potential risks involved in exposing the whole population to higher levels of folate. Voluntary fortification is not efficient as women likely to consume the fortified bread are those that are also likely to take supplements. The unplanned mothers and the uninformed, which are the targets for mandatory fortification, will not be reached. Following the introduction of voluntary fortification in 1996 a study in 2003 (Hazel Fowler, 2006) shows the average folate intake of woman increasing by only 17mcg per day.

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Although I welcome mandatory fortification of folic acid to bread, I believe that flour would be much more suitable as the vehicle. According to the NZ Food Safety Authority, fortifying bread directly "gives the industry the flexibility to add folic acid at any point in the manufacturing process". However, this simply adds more work for the bakers, costs more, is more difficult to monitor and adds a liability to human error. Although the upfront costs of purchasing equipment are higher, fortification of flour is estimated to cost \$29.3 million per year ongoing (Access Economics, 2006), almost 20 million less than bread. This will reach even the women that do not regularly consume bread.

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This should be coupled by ongoing campaigns for folic acid supplementation, as well as increasing the accessibility of supplements through government subsidy. In order to have a successful campaign an area must have a low amount of unplanned pregnancy and an intensive educational promotion.

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