



Potassium as the Key Ingredient in Salt - A Review Paper

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ABSTRACT

These days, salts with a high sodium content are seen as a health risk. A high sodium intake raises blood pressure because it causes the body to retain more fluid, which puts more strain on the heart. Even staples like cereal and bread can have a lot of salt. Potassium-based salts have distinguished themselves from the other noteworthy choices by demonstrating a high nutritional efficiency. It has numerous negative side effects as well as similarities to table salt (NaCl). The most significant salt alternative, KCl, has a side that tastes mostly harsh, caustic, and metallic. Taste enhancers may be employed to commercially formulate the products for service. The flavour enhancers approach to marketing a product is distinct. Through the lenses of food science and safety, this review offers a new perspective on the topic of potassium chloride (KCl)-based salts as opposed to sodium-based salts offering health benefits. The nutritionally recognised mineral salts, amino acids and their salts, simple carbohydrates and sugar replacements, food acids, spices, and vegetables play a crucial role as flavour enhancers in KCl-based salts. In order to further reduce salt intake and enhance potassium intake, this research discusses the possible benefits of using salt substitutes in addition to salt reduction measures.

KEYWORDS: Salt, Potassium Chloride Salt, Sodium Chloride Salt, Taste Enhancers, Health

"The addition of the term salt to potassium chloride may encourage manufacturers to use this sodium alternative and help consumers understand that potassium chloride can replace sodium chloride in foods. This may help to reduce the intake of sodium, which is over-consumed by the population, while increasing potassium, which is under-consumed." Salt is potentially one of the world's most important cooking ingredients. Without it, many meals would taste bland and tedious. However, not all salts are created equal. There are many varieties to choose from. Apart from taste and texture, they differ in minerals and sodium content. Salt and sodium are often used interchangeably, but they're not the same thing. Sodium is a chemical element with the symbol Na and a mineral that can be found in foods naturally or added artificially during production. The ingredients of table salt are sodium and chloride. It contains roughly 40% sodium and 60% chloride by weight. Common or table salt, or NaCl, is the main source of sodium ions in the diet. It enters by three different routes, the first of which is from foods that already naturally contain sodium chloride. The second is through the addition of sodium chloride and other sodium salts to processed foods, and the third is through the addition of sodium chloride to food either during cooking or right before eating. The last

two pathways are the major reason for excessive sodium ion intake in the diet (Roan lii Charles F 1984). A high sodium intake raises blood pressure because it causes the body to retain more fluid, which puts more strain on the heart (He FJ and Li J 2013). In most people, the kidneys have trouble keeping up with excess sodium in the blood. Moreover, the removal of sodium chloride from the human diet poses difficult problems. Deficiency of sodium is rare because it is so commonly added to a wide variety of foods and occurs naturally in some foods (figure 1). The food industry is actively engaging in reducing the sodium content of food products (Belohlawek 1997). To ensure that products with lower sodium content remain in market niche and in demand among consumers, sodium reduction in food products must be concluded in a manner that further does not lead to decrease in product quality (Leo Van Buren 2016). Although sodium and potassium are closely related, their effects on the body are diametrically opposed. Both are vital nutrients that are crucial for preserving physiological equilibrium and have been associated with an increased risk of chronic diseases, particularly cardiovascular disease (Preuss HG) 2012). High potassium intake can assist relax blood vessels and help the body eliminate sodium while lowering blood

pressure, whereas high salt intake raises blood pressure and can contribute to heart disease. Every day, our bodies require significantly more potassium than sodium. Potassium chloride salt as a replacement for table salt has several associated health benefits, namely that it reduces sodium intake and increase potassium intake (Mary Ellen Kuhn 2010). Sodium based salts are nowadays considered as a factor of concern for human health. KCl has resembling properties like common salt (NaCl), alongside multiple unwanted side effects. The most important salt substitute i.e., KCl has a relatively tilting side that tastes; bitter, acrid, and metallic (Katica Cepanec 2017). There have been multiple attempts that have been made to overpower the bitterness of salt substitutes containing potassium chloride

(Roan lii Charles F 1984). Hence for the efficiency for the salt substitutes taste enhancers may be used to overcome the facts of its sensory drawbacks. It has been found that other supplements are required to mask the bland taste of KCl. Mono potassium glutamate or glutamic acid, choline, fumaric acid, ascorbic acid and citric acid have been used in different ratios with certain amount of success as additives to mask the bitter taste (Akzona 2010). It is a thesis of the present invention to provide a salt substitute having desirable positive flavour characteristics in addition to a salty flavour (Roan lii Charles F 1984). Moreover, the documents have higher scientific information than the inventors have calculated through experimental data.

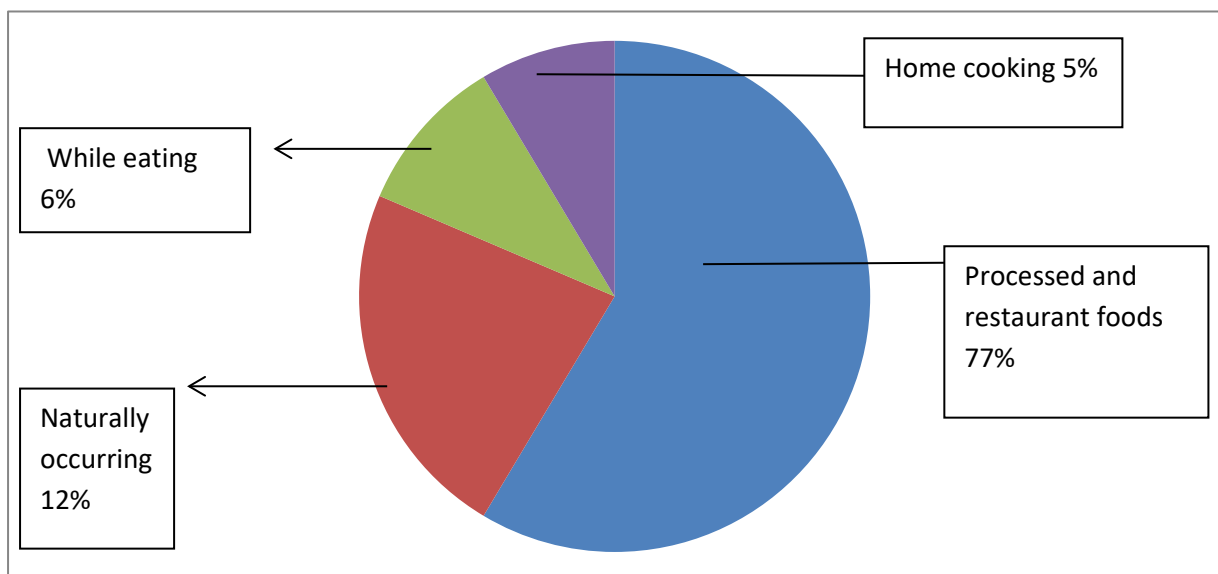


Figure 1: Sodium intake pie chart

USAGE OF POTASSIUM AND POTASSIUM CHLORIDE IN HUMAN BODY

Like how sodium chloride is collected from rock and sea salts, potassium chloride is a naturally occurring mineral salt. Potassium's significance is greatly underrated. Surprisingly, a diet high in potassium has several health advantages. Elson M. Haas is a doctor. Fruits, vegetables, and whole grains make up the naturally advised diet, which is high in potassium and low in salt. It lowers blood pressure and cell water retention, guards against stroke, fights osteoporosis (bone thinning), and lessens the risk of kidney stones and high blood pressure. You can keep your nervous system functioning normally by eating a diet high in the recommended amount of potassium. The presence of potassium naturally in foods supports the safety of oral potassium chloride ingestion (Leo Van Buren 2016). 4.7 g/day of potassium is the recommended intake quantity to decrease the negative effects of sodium chloride. Our bodies' principal potassium regulators are the kidneys, which keep blood levels stable despite significant dietary variance. A fluid used in dialysis that contains potassium chloride aids in maintaining the body's

electrolyte equilibrium. When compared to sodium, potassium penetrates cells more easily, starting the sodium-potassium exchange between cells. The excretion of potassium from the cell alters the potential of the cell membrane, enabling the transmission of the nerve impulse. This "sodium-potassium pump"-induced electrical potential gradient aids in muscle contractions and controls heartbeat. The fact that it stops cell swelling is one of its other most crucial functions. If sodium is not eliminated, water builds up inside the cell, causing it to grow and eventually rupture. In addition to playing a key role in energy metabolism and intracellular biochemical processes, potassium also helps the cell's amino acid-based protein synthesis process. Potassium is necessary for healthy growth and muscle development. Potassium aids in the metabolism of carbohydrates; it is involved in the conversion of glucose to glycogen, which is then stored in the liver as a source of energy in the future. The kidneys continue to discharge potassium even when the body is deficient in it. It is crucial to work toward maintaining the potassium balance in the body since it is necessary for a regularly beating heart and a healthy neural system.

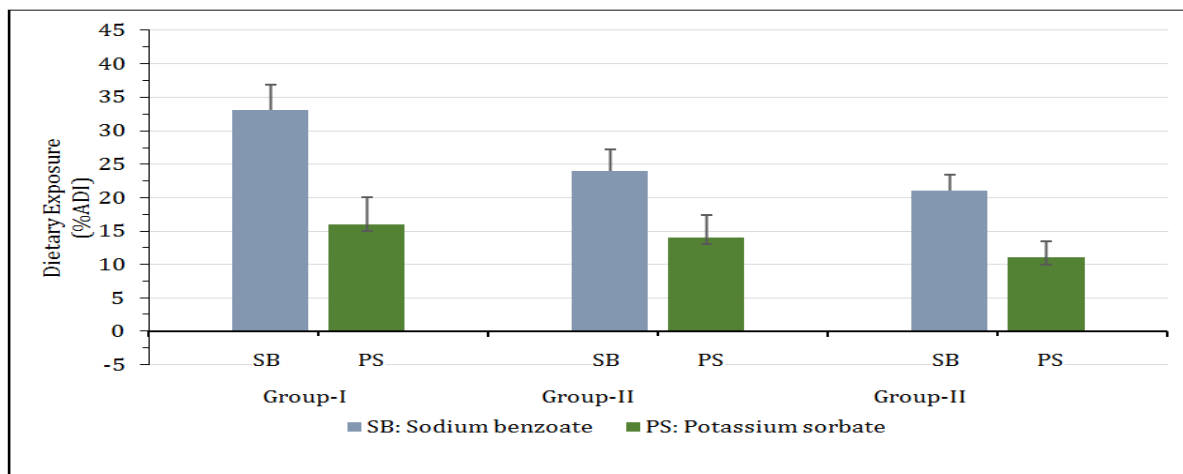


Figure 2: States that amount of sodium intake is comparatively high than potassium that leads to potassium deficiency and other serious problems.

Table 1: Adequate intake amount of potassium in human beings.

Age	Male(mg)	Female(mg)
Birth to 6 months	400	400
7-12 months	860	860
1-3 years	2000	2000
4-8 years	2300	2300
9-13 years	2500	2300
14-18 years	3000	2300
19-50 years	3400	2600
51+ years	3400	2600

SOURCES OF POTASSIUM

Different types of food contain potassium. Numerous foods are low in sodium and high in potassium, which, as has already been mentioned, helps to avoid hypertension [Elson M. Haas, M.D.]. While less potassium is lost when fruits or vegetables are frozen, a

significant quantity is lost when food is processed or canned. Potassium levels are high in leafy green vegetables including spinach, parsley, lettuce, broccoli, peas, Lima beans, tomatoes, and potatoes, especially the outer skins. Citrus fruits, bananas, apples,

avocados, raisins, and apricots, especially dried ones, are among the fruits high in potassium. Potassium is also abundant in seeds, nuts, whole grains, and wheat germ. Fish with high potassium levels include flounder, salmon, sardines, and cod. Many animal items also have more potassium than sodium, despite typically having additional

sodium salt added. Additionally, herbs like red clover, sage, catnip, hops, horsetail, nettle, plantain, and skullcap contain potassium. Nicotine and caffeine inhibit potassium absorption. Alcoholics, drug abusers, and crash dieters are at a higher risk of having insufficient potassium consumption.

ENERGY (kcal/d)	POTASSIUM (mg)
1600	22880
2000	3600
2400	4320
2800	5040
3200	5760

Table 2: Amount of energy (kcal/d) produced by the intake of potassium (mg) from different sources mentioned above.

DEFICIENCY AND TOXICITY OF POTASSIUM

The increment or reduction of potassium has many ill effects and, in the extreme, can even cause death. Maintenance of steady levels of potassium in the blood cells is vital for the normal body functioning.

Moreover, even in the high case of potassium intake, the kidneys still intend to clear the excess amount, and blood level remains consistent. The elevation of potassium levels leads to hyperkalaemia including other

complimentary factors while decrease the major reason being is the decrease in renal function. The functioning of heart is affected by hyperkalaemia, the change in electrocardiogram can be seen (Viera AJ 2015).

Potassium deficiency is a widespread issue, especially in adults or those with chronic illnesses [Elson M. Haas, M.D.]. Low potassium levels in the body can also cause hypertension, congestive heart failure, cardiac arrhythmia, lethargy, depression, and erratic mood swings. The decrease in potassium

levels in the body is caused by several circumstances. Potassium levels steadily drop because of diarrhoea, vomiting, and other gastrointestinal issues. Infants with diarrhoea must be monitored for hypokalaemia, or low blood potassium (Ayach T 2014). Variations in potassium levels may be caused by renal illness and diabetes. Diuretic medication is the drug most likely to produce hypokalaemia, but other drugs like laxatives, aspirin, digitalis, and cortisone can also deplete potassium over time (Ayach T 2014). Heat waves and excessive perspiration can deplete potassium stores and contribute to dehydration, as potassium and sodium are excreted out of the body along with potassium. Most people quickly receive potassium supplements or foods that are high in potassium. People who consume too much sugar or sodium may become potassium deficient. People who consume too much sodium also excrete

excessive potassium through their urine. The most frequent symptom of chronic potassium deficiency is fatigue or tiredness. Early symptoms include measured reflexes, dry skin, or acne; these embryonic issues may progress to neurological diseases, sleeplessness, irregular heartbeats, and a loss of gastrointestinal tone (Connie M Weaver 2013). A sudden drop in potassium levels might cause heart arrhythmia. Blood sugar levels may rise because of low potassium levels weakening glucose metabolism. Serious muscle weakness, brittle bones, alterations in the central nervous system, slowed heart rate, and occasionally even death can result from more severe potassium deficit. The most important blood mineral in medicine is potassium, thus any deficit must be carefully monitored and treated right away using potassium supplements.

SODIUM INTAKE	The quantity of sodium intake per day (mg/day)	4533.17 ±30.24
POTASSIUM INTAKE	The quantity of potassium intake per day (mg/day)	3104.64 ±15.97

Table 3: The amount of sodium and potassium intake per day clearly states that the amount of sodium intake is higher that leads to deficiency of potassium further progressing to diseases and other toxicity symptoms.

TASTE ENHANCERS FOR BITTER TASTE

The sensory evaluation states that KCl tastes bitter, acrid and metallic (Sinopoli and Lawless 2012) and has to be compensated with taste enhancing agents/substances/ingredients. The pivotal role played by the taste enhancers in KCl based salts are the nutritionally accepted mineral salts, amino acids and its salts, simple carbohydrates and sugar substitutes, food acids, spices, vegetables (Bonorden WR 1997).

Many inorganic salts have been utilized as taste enhancers for potassium chloride. Certain examples of these organic salts are calcium chloride (CaCl_2), calcium sulphate (CaSO_4), magnesium sulphate (MgSO_4) etc. as well as some of their isolated combinations (Deveau 1993). A combination of ($\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$) and ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) enacts as a practical taste enhancer for KCl substitute. Similarly, the appropriate ratio of MgCl_2 and MgSO_4 can be effectively used salting (Bonorden 1997).

Addition of amino acids that includes acetic acid, malic acid, lactic acid, fumaric acid, tartaric acid take part in metabolic cycles occurring in human body is the other efficient substitute for taste enhancers. Potassium

succinate and potassium fumarate may also be used as taste enhancers in KCl substitute (Perry and Ladenberg 1956). The other amino acid salt is magnesium hydrogen citrate which is used as the taste improver for KCl salt substitute providing effect against bitter taste (Schwaiger 1989).

The most beneficial among all other KCl based salt taste enhancers are sugar alcohols. They are comparatively less sweetening and are weaker than sucrose while comparing the same weight basis. The bitterness of the KCl can be overcome by the use sorbitol, mannitol, xylitol, lactitol etc. (Kitada 1985).

The addition of herbs, vegetables, and certain seasoning spices is not a new idea. It is used in cooking to enhance the taste of the food. Herbs like garlic (*Allium sativum*), onion (*Allium cepa*), cumin (*Cuminum cyminum*), oregano (*Origanum vulgare*), black pepper (*Piper nigrum*), ginger (*Zingiber officinale*), coriander (*Coriandrum ativum*), turmeric (*Curcuma longa*), black mustard (*Brassica nigra*), saffron (*Crocus sativus*) etc. can be used while vegetables such as chilli (*Capsicum annum*), capsicum (*Capsicum spp.*), broccoli (*Brassica oleracea*), maybe used. The combinations of each in certain ratio are ideally used for cooking at home.

CONCLUSION

Potassium is the most important nutrient required by human body which is not typically found in fortified foods or regularly consumed dietary supplements. Encouraging the use of potassium chloride in food products as a viable sodium replacement will be the best strategy for healthy living. Potassium chloride salt substitute can be the most effective to reduce sodium intake in diet. Alternating commercially added sodium chloride by potassium chloride as shown in the newly designed modelling scenarios could have a positive donation to obtaining a healthy ratio in the population. To neglect the tilting

side of KCl i.e., bitter, acrid and metallic taste; the use of taste enhancers be promoted. Taste enhancers could be herbs, vegetables, spices, sugar alcohols, organic salts or amino acids. KCl helps in reducing hypertension and improves the bone health. The natural potassium salts in food have a wide variety of advantages to bones, kidneys, and heart. Potassium chloride has been accepted by WHO for the use in food products and is considered valuable and safest replacement for NaCl. The increment of potassium chloride is currently the most applied practice to replace sodium chloride in foods while preserving a similar-saltiness.

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