Volume 9, Issue 2, February – 2024 International Journal of Innovative Science and Research Technology
ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24FEB1442

Salt in Meat Products and Health

Martina Stvorić
Aspira University of Applied Sciences
Zagreb, Croatia

Abstract:- For the human body to function correctly, salt is necessary, but it can also have negative effects. Long-term overconsumption of salt in food can result in major health issues and complications. Excessive consumption of salt can lead to high blood pressure, a problem that affects people all over the world, heart attacks, strokes, kidney diseases, and certain types of cancer. One of the main sources of salt in the human diet is the food industry, which includes the meat industry. Salt is added to food in amounts that are more than enough to enhance its flavour without compromising the body's ability to function normally. Simultaneously, consuming higher amounts of meat products on a daily basis results in an increased salt intake within the body. Numerous initiatives and plans are being developed to lower salt consumption through diet in an effort to stop the onset of various diseases associated with high salt consumption.

Keywords:- *Salt, Blood Pressure, Disease, Food Industry.*

I. INTRODUCTION

As the primary dietary source of protein and energy for the body, meat and meat products are considered essential foods for a large number of people. Meat is the ideal medium for microorganisms to grow because it is so full of different nutrients. Meat undergoes various conservation procedures, the most popular of which include processing and the addition of chemical additives to extend its shelf life and impede the growth of naturally occurring microorganisms. Various techniques are employed in the production process of meat products nowadays, such as size reduction, mixing, salting, drying, smoking, use of heat, etc. [1].

For the human body to function normally, proper salt intake must be insured, daily needs being 5 to 6 grams [2]. Nonetheless, daily salt consumption far surpasses the advised daily allowance. The human body is genetically predisposed to a salt intake of less than one gramme per day, in contrast to our distant evolutionary ancestors. Adding salt to food began 5,000 to 10,000 years before agriculture began [3]. The main purpose of salt in food is to improve flavour; that is, adding salt makes the food taste better. As a preservative, salt also plays a significant role in extending the shelf life of food. The preservative properties of salt are a major justification for their use in the meat industry. Salt reduces water activity (aw) in food and thus slows down or inhibits the growth of microorganisms, especially pathogenic ones [4].

Overconsumption of salt is detrimental to human health and frequently results in hypertension. Chronic and untreated hypertension over a long period increases the risk of developing heart, brain, and kidney diseases and complications [5]. Overconsumption of salt in food is a serious public health issue, and the primary food sources of sodium are: industrial food products (77%), natural sodium content in food (12%), salting food and meals during meal preparation and consumption (6%) [2]. Of all the food products made in factories, the following have the most salt: baked goods, meat products and dried meat products, pasta, dehydrated soups, concentrates, spices, etc. [6]. Nowadays, people who eat partially prepared and semi-finished foods as well as meals cooked in restaurants contribute significantly to their body's salt intake [7].

II. SALT IN MEAT PRODUCTS

According to s source and manufacturing process, might include magnesium or other salts [8].

The following are the primary technological purposes of salt in food and meat products: it enhances the taste and aroma of food, acts as a preservative, affects the texture of the product, and increases the cost-effectiveness of production because it reduces the loss of water from the product [9].

One of the first antimicrobial agents to be used as a preservative was salt, which has long been used to preserve food. Salting as a method of preservation, especially of meat products, has been used since the earliest civilizations [10]. By means of osmosis, salt extracts water and microbes from food cells. Although new methods have appeared today that extend the shelf life of meat and meat products, salt is still used for these purposes, especially in the production of cured meat products [11]. Salt concentrations of 0.5% to 1.5% do not significantly affect the inhibition of the growth of pathogenic microorganisms [10]. Reducing the salt content below recomRegulation on Salt, salt is a crystallization product that primarily consists of sodium chloride (NaCl), which, depending on itmended levels without adding additional preservatives shortens the product's shelf life [9]. To exemplify, there is a comparison between hamburger bacon with less than 1% of salt and bacon with 2-3% of salt. Bacon with less than 1% salt at a storage temperature of 6 °C for 2 weeks develops a sour taste, compared to bacon with 2-3% salt, which under the same storage conditions develops a sour taste only after 3 weeks [12]. The technical process used to produce meat products, particularly those that are dry-cured, frequently

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24FEB1442

includes the salting of meat. The outer, or extracellular, surface of the product gains more salt concentration when meat is salted. As a result, there is a decrease in the concentration of extracellular salt due to a concentration gradient that drives water from the intracellular space to the surface. In this way, water activity and the proportion of water in the intracellular space are reduced. The growth of pathogenic bacteria is slowed down when water activity is less than 0.9 [13]. Apart from its ability to reduce water activity and act as a preservative, salt also has a unique effect through the inhibition of specific enzymes by chloride ions (Cl-), which alter the metabolism of microorganisms [14]. Chlorine from salt also acts as an oxidant, preventing the lipolysis of fatty tissue, i.e. it acts as an inhibitor of lipolytic enzymes and in this way, it is possible to preserve the quality of traditional meat products that have a long maturation [15]. There are two methods to preserve meat with salt: wet salting, which involves submerging the meat in a brine mixture and injecting the brine into the meat's interior, or dry salting, which involves applying salt to the meat's surface [16].

Moreover, food's organoleptic qualities—that is, its flavour and aroma—are improved by the addition of salt. The product's taste is influenced by ions such as sodium and chloride. The product's sensory attributes are composed of salt and meat-based fat. In products that contain more fat with added salt, the salty taste will be more prominent compared to less fatty products [9]. The texture (softness and juiciness) of meat products is also impacted by salting and salt addition. Myofibrillar proteins' melting point is raised by salt, which also improves meat's ability to bind water. This increases production efficiency because less mass is lost during the melting process, but at the same time the softness and juiciness of the finished product increases [12]. Meat can be cut more easily with the help of salt, and when chewed, the meat eventually becomes softer and more soluble—a very significant characteristic [17].

There is variation in the amount of salt added to meat products. For example, mould does not grow at water activity values below 0.83 and bacteria that cause food spoiling do not grow at values lower than 0.91. Also, bacteria that cause spoilage and poisoning, such as Listeria monocytogenes, Staphylococcus aureus, Salmonella sp., and E. coli O157:H7, can survive at water activity values of 0.96 to 0.97, and these water activity values are equivalent to the mass fraction of salt in the finished product from 2 to 2.6%, which means that these values of salt content are not sufficient for high-quality food preservation with only the addition of salt [18,19]. A study was carried out to ascertain the mass fraction of salt in a variety of traditional Croatian products. (Table 1), where the mass fraction, depending on the product, ranged on average between 4 and 6.5% [20]. For example, the average proportion of salt in the mixture for sausages is from 2 to 2.6%, and the finished product made by drying sausages has between 3.3 and 4.4% salt (g) [21].

Table 1. Average Mass Fraction of Salt in Different Traditional Croatian Meat Products [20]

PRODUCT CATEGORY	GROUP OF PRODUCT	TYPE OF PRODUCT	AVERAGE MASS FRACTION OF SALT (%)
SAUSSAGES	Preserved sausage	Homamade sausage	4.14
		Kulen sausage [a]	4.37
CURED MEAT PRODUCTS	Preserved cured meat products	*Prosciutto* [b]	6.34
		Dry-cured ham	6.52
		Dry-cured pork neck	5.46
		Dry-cured pork shoulder	5.45
	Semi-preserved cured meat products	Smoked *pečenica* [c]	5.34
		Smoked pork neck	4.92
BACON	Semi-preserved bacon	Bacon	5.09
		Špek [d]	5.52
	Preserved bacon	*Pancetta* [e]	5.57

[a]: a type of traditional meat sausage formed from pork intestine bags and spiced with minced pork meat
[b]: type of a traditional meat made from minced pig leg that has been salted and dried for a number of months
[c]: type of typical Dalmatian pork product that has been salted, cold-smoked, and dried in the Bora wind
[d]: type of traditional pork meat product that has been brined, smoked and dried for around 45-55 days
[e] type of traditional pork meat product with Mediterranean spices that has been salted and dried in Bora wind

III. THE INFLUENCE OF SALT ON HUMAN HEALTH STATUS

Several million years ago, human ancestors and other mammals consumed food that contained less than 0.25 g of salt per day, but 5000 years ago the Chinese discovered that salt could be used for meat consumption and that's when people started consuming more salt through food. At the end of the 19th century, there was a revolution in salt intake during which the average salt intake increased to 9 to 12 g per day in a large number of countries in the world, the reason being the production and preparation of food with large portions of salt [22]. Long-term, excessive salt consumption results in arterial hypertension, which, if left untreated, can develop into other diseases and complications. The World Health Organisation advises against consuming more salt because of these factors; the recommended daily allowance is less than 5 grammes [23]. According to data from the former Croatian Food Agency, the average salt intake in the Republic of Croatia is 11.6 g

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24FEB1442

per person per day, which is twice as much as recommended by the World Health Organization [7]. Long-term, excessive salt consumption results in arterial hypertension, which, if left untreated, can develop into other diseases and complications. The World Health Organisation advises against consuming more salt because of these factors; the recommended daily allowance is less than 5 grammes [23].

However, one should be aware of the detrimental effects that prolonged excessive salt consumption has on human health. Hypertension or high blood pressure is one of the biggest risk factors for the development of cardiovascular diseases. Cardiovascular diseases are chronic non-communicable diseases that are the leading cause of mortality in the world [24].. High blood pressure is the single largest cause of heart disease and stroke, with an estimated 49% of heart disease and 62% of stroke [25]. Estimates that 37% of the population in Croatia suffers from hypertension, which is more than a third of the population [26]. The main cause of hypertension is high salt intake, as indicated by numerous studies [5]. In older adults, cutting back on salt consumption significantly lowers blood pressure; in younger adults, the reduction is less noticeable [27]. Chronic arterial hypertension leads to damage to blood vessels, heart muscle, and kidneys [28]. Stroke is the third most common cause of death worldwide and the second most common cause of death in the Republic of Croatia. The most common predictor of the onset of this condition is arterial hypertension [29].

Research in China, which suggests that people who consume large amounts of salt are twice as likely to develop a stroke [30]. Excessive salt intake leads to the kidneys excreting sodium excessively, which then leads to increased calcium loss, and all of this increases the risk of kidney stones and the development of osteoporosis [7]. Postmenopausal women have been found to have increased urinary calcium excretion as a result of natriuresis and high salt intake. Due to the loss of calcium, the body begins to use compensatory mechanisms, one of the basic mechanisms being bone resorption of calcium [31]. Stomach cancer is the fourth most common cancer in the world and the second deadliest cancer among all cancers [32]. It was confirmed that there is a positive correlation between the incidence of stomach cancer and excessive salt consumption. Consuming too much salt irritates the stomach mucosa, which frequently results in inflammation. If an ulcer is already present on the gastric mucosa, the possibility of infection with the bacterium Helicobacter pylori is increased, which results in a higher risk of developing malignant changes in the stomach [7].

IV. METHODS OF SALT REDUCTION

Reducing salt consumption through diet is crucial for preventing the onset of many diseases, particularly those classified as chronic non-communicable diseases. Numerous programmes are in place in the Republic of Croatia and throughout Europe to encourage a decrease in the amount of salt consumed. National implementation of the Croatian Action on Salt and Health (CRASH) programme is underway. This program developed based on a program established in Great Britain in 1996, known as Consensus Action on Salt and Health - CASH, whose main goal was to make people aware of excessive salt intake and encourage the food industry to reduce salt in food products [33]. A survey was carried out in Great Britain in 2001 to ascertain the average amount of salt consumed by adult individuals. Urine samples were collected every 24 hours to measure the amount of sodium in the urine (a technique for measuring salt intake). According to the study, an adult typically eats 9.5 g of salt daily. Some rough estimates say that of the 9.5 g of salt ingested per day, 15% comes from adding salt during cooking and eating meals, 5% is naturally present in food, and the other 80% comes from processed food products (semi-prepared and ready meals) and food consumption in restaurants and fast food facilities. Given these results, salt intake should be reduced by 40%, and based on this, a strategy for reducing salt intake from individual sources was created (Table 2). The intake of ready-made and semi-ready meals bought in food stores should be reduced to the greatest extent, and there are also requirements towards the food industry that encourage the reduction of salt addition or its replacement by some other sources [22].

A large number of meat products contain quite a high concentration of salt, which is added due to various technological tasks [34]. Reducing the amount of salt added in the meat industry is therefore a significant technological challenge. The food industry uses a lot of salt to cover up cheap, tasteless food products. This makes the food tasty and affordable, making it available to a larger population [22].

In the Republic of Croatia, about 50% of the required daily amount of salt is taken in through traditional meat products, depending on the region. At the same time, slightly more salt is consumed in Eastern and Central Croatia, about 60% of the total daily needs compared to Dalmatia and Istria, where about 40% of the total daily salt needs are taken in through these products [20]. Given that meat products are often consumed, it is precisely for these reasons that there should be a push to reduce the amount of salt added to them. In addition to directly reducing the amount of salt in products, one can also use mixtures that contain a smaller amount of NaCl and other salts, most commonly carbonates, sulphates, and chlorides. However, people must be cautious when using these mixtures because large additions can alter the flavour and add an unwelcome bitterness. Enhancers of flavour are another good option; their goal is to make food taste better. In this manner, the amount of salt can be decreased while preserving the distinct salty flavour of the food through the use of flavour enhancers (such as nucleotides, inosinate, and guanylate) [35, 36]. People should strive to reduce salt in food in all areas, because in this way, the health system could be relieved to a large extent and the money needed for the treatment of other diseases could be saved [7].

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24FEB1442

Table 2. Strategy For Reducing Salt Intake In The Uk [22].

SALT INTAKE		NECESSARY REDUCTIONS
SOURCE	g per day	
Cooking and adding salt	1.4	40% (0.9 g per day)
Naturally present salt in food	0.6	Reduction not necessary
Food industry, restaurants	7.5	40% (4.5 g per day)

V. CONCLUSION

Salt is obviously required for normal operation, but if used carelessly, it can create situations that are hazardous to people's health and lives. Reducing the amount of salt added during production should be the main objective, as this will affect the food and consequently the meat industries. Numerous studies should be carried out to identify potential suitable replacements that would enable the product to maintain its standard technological and sensory characteristics, as this presents a significant financial and technological challenge. Even though meat products are frequently the food of choice for many people, bread goods, which are frequently eaten with meat products, are also a concern. These combinations significantly exceed the recommended daily intake of salt. Continuous population education is necessary, in addition to the impact on the industry. Increasing knowledge of the negative effects of salt on the body and the ways to cut back on salt consumption should be the main objectives. While a multidisciplinary approach is undoubtedly necessary, we can also achieve the desired results in smaller steps, which will primarily lower health system costs and lower mortality from chronic non-communicable diseases—our silent killers.

REFERENCES

[1]. Toldrá, F. (2010). Handbook of Meat Processing. Ames: Blackwell Publishing.

[2]. Mattes, R.D., Donnelly, D. (1991). Relative contributions of dietary sodium sources. Journal of the American College of Nutrition, 10(4): 383-393.

[3]. Meneton, P., Jeunemaitre, X., De Wardener, H.E., Macgregor, G.A. (2005). Links Between Dietary Salt Intake, Renal Salt Handling, Blood Pressure, and Cardiovascular Diseases. Physiol Rev, 85: 679–715

[4]. Commission nationale d'examen sur l'assurance-emploi (CTAC) (2009). Conseil de la transformation agroalimentarie et des produits de consommation. Reformulation of products to reduce sodium. Salt reduction guide for food industry. Montreal, Canada.

[5]. Brown, I.J., Tzoulaki, I., Candeias, V., Elliott, P. (2009). Salt intakes around the world: implications for public health. International Journal of Epidemiology: 38:791–813.

[6]. Kaić-Rak, A., Pucarin-Cvetković, J., Antonić-Degač, K., Laido, Z. (2010). Unos soli u prehrani školske djece u RH. Hrvatski Časopis za javno zdravstvo: 6 (21).

[7]. Hrvatska agencija za hranu (HAH) (2014). „Manje soli – više zdravlja". Osijek, Republika Hrvatska.

[8]. Ministarstvo poljoprivrede, ribarstva i ruralnog razvoja (2011). Pravilnik o soli. Narodne novine 89 (NN 89/2011).

[9]. Žlender, B. (2009). Smanjenje koncentracije soli u mesnim proizvodima. Meso: Prvi hrvatski časopis o mesu: 11(3): 189-195.

[10]. Doyle, M.E., Glass, K.A. (2010). Sodium Reduction and Its Effect on Food Safety, Food Quality, and Human Health. Compr Rev Food Sci Food Saf: 9(1):44-56.

[11]. Coultate, T.P. (2001). Food: The Chemistry of its Components. Cambridge: The Royal Society of Chemistry.

[12]. Desmond, E. (2006). Reducing salt: A challenge for the meat industry. Meat Science: 74(1): 188-196.

[13]. Krvavica, M., Mioč, B., Friganović, E., Kegalj, A., Ljubičić, I. (2012). Sušenje i zrenje – temeljni tehnološki procesi u proizvodnji trajnih suhomesnatih proizvoda. Meso: Prvi hrvatski časopis o mesu: 14(2), 138-144.

[14]. Duraković, S., Delaš, F., Duraković, .L (2002). Moderna mikrobiologija namirnica. Zagreb: Kugler.

[15]. Kovačević, D. (2014). Tehnologija kulena i drugih fermentiranih kobasica. Osijek: Sveučilište Josipa Jurja Strossmayera u Osijeku, Prehrambeno-tehnološki fakultet Osijek.

[16]. Belitz, H.D., Crosch, W., Schieberle, P. (2009). Food Chemistry. Berlin: Springer

[17]. Ruiz-Ramirez, J., Serra, X., Arnau, J., Gou, P. (2005). Relationship between water content, NaCl content, pH, and texture parameters in dry–cured muscles. Meat Science: 70(4): 579-587.

[18]. Heinz, G., Hautzinger, P. (2007). Meat processing technology for small- to medium-scale producers. Bangkok: Food and Agriculture Organization of the United Nations Regional Once for Asia and the Pacific.

[19]. García-González, D.L., Tena, N., Aparicio-Ruiz, R., Morales, M.T. (2008). Relationship between sensory attributes and volatile compounds qualifying dry-cured hams. Meat Science: 80(2) 315–325.

[20]. Pleadin, D.J., Koprivnjak, P.O., Tomljanović, A., Krešić, P.G., Gross-Bošković, A., Služek, V.B., Kovačević, P.D. (2015). Dnevni unos soli putem tradicionalnih mesnih proizvoda u Hrvatskoj. MESO: Prvi hrvatski časopis o mesu, 17(6): 534-540.

[21]. Kovačević, D., Suman, K., Lenart, L., Frece, J., Mastanjević, K., Šubarić, D. (2011). Smanjenje udjela soli u domaćoj slavonskoj kobasici: utjecaj na sastav, "fizikalno-kemijska svojstva, boju, teksturu, senzorska svojstva i zdravstvenu ispravnost. Meso: Prvi hrvatski časopis o mesu: 13(4): 244-249.

[22]. He, F.J., MacGregor, G.A. (2009). A comprehensive review of salt and health and current experience of worldwide salt reduction programs. J Hum Hypertens: 23(6):363-84.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24FEB1442

[23]. World Health Organization (WHO) (2012). Guideline: Sodium intake for adults and children. Geneva, Switzerland.
[24]. Živković, R. (2002). Dijetetika. Zagreb: Medicinska naklada.
[25]. World Health Organization (WHO) (2002). Reducing Risks, Promoting Healthy Life. Geneva, Switzerland.
[26]. Pucarin-Cvetković, J. (2013). 100 (i pokoja više) crtica iz znanosti o prehrani: Sol u prehrani – čimbenik rizika od razvoja kroničnih nezaraznih bolesti. Zagreb: Hrvatsko društvo prehrambenih tehnologa, biotehnologa i nutricionista.
[27]. Law, M.R., Frost, C.D., Wald, N.J. (1991). How much does dietary salt reduction lower blood pressure? I--Analysis of observational data among populations. BMJ: 302(6780):811-815.
[28]. Antonios, T.F., MacGregor, G.A. (1995). Salt intake: potential deleterious effects excluding blood pressure. J Hum Hypertens: 9(6):511-5.
[29]. Vrhovac, B., Jakšić, B., Reiner, Ž., Vucelić, B. (2008). Interna medicina. Zagreb: Naklada Ljevak.
[30]. Liang ,W., Lee, A.H., Binns, C.W. (2011). Dietary Intake of Minerals and the Risk of Ischemic Stroke in Guangdong Province, China, 2007-2008. Prev Chronic Dis: 8(2): A38.3Harrington, M., Bennett, T., Jakobsen, J., Ovesen, L., Brot, C., Flynn, A., Cashman, K.D. (2004). Effect of a high-protein, high-salt diet on calcium and bone metabolism in postmenopausal women stratified by hormone replacement therapy use. Eur J Clin Nutr: 58(10):1436-1439.
[31]. Harrington, M., Bennett, T., Jakobsen, J., Ovesen, L., Brot, C., Flynn, A., Cashman, K.D. (2004). Effect of a high-protein, high-salt diet on calcium and bone metabolism in postmenopausal women stratified by hormone replacement therapy use. Eur J Clin Nutr: 58(10):1436-1439.
[32]. Kranjčević, K. (2015). Karcinom želuca u praksi liječnika obiteljske medicine. Acta Med Croatica: 69 (2015): 333-338.
[33]. Jelaković, Ž., Premužić, V., Skupnjak, B., Reiner, Ž. (2009). Kuhinjska sol-skriveni otrov u svakodnevnoj hrani. Liječnički Vjesnik: 131(5-6):146-154.
[34]. Rios-Mera, J.D., Selani, M.M., Patinho, I., Saldaña, E., Contreras-Castillo, C.J. (2021). Modification of NaCl structure as a sodium reduction strategy in meat products: An overview. Meat Science: 174.
[35]. Toldra, F., Barat, J.M. (2009). Recent Patents for Sodium Reduction in Foods. Recent Patents on Food, Nutrition & Agriculture: 1:80-86.
[36]. Doko Jelinić, J., Nola, I.A., Andabaka, D. (2010). Prehrambena industrija – udar soli na potrošače. Acta Med Croatica: 64(2):97-103.