

Lörtsy: is there a future for this traditional Finnish food?

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Abstract

The aim of this study is to reformulate the traditional Finnish food *lörtsy* to better align with the principles of planetary health. The work examines the biodiversity and health impacts of key ingredients in the original recipe and evaluates how modifying these ingredients can enhance the dish's contribution to both human and environmental well-being. The reformulated *lörtsy* was prepared by baking in the oven instead of traditional deep-frying. Traditional wheat dough was modified by substituting part of the wheat flour with whole-grain flour, and a plant-based filling was chosen instead of meat. Changing the preparation method and the ingredients of the filling resulted in a higher fiber content and decreased total and saturated fat content. Replacing meat and rice reduced the product's nature footprint by 48 % and 26 %, respectively, compared to the original.

Keywords

biodiversity, health, *lörtsy*, traditional food

1. Introduction

This study aims in analysing the traditional *lörtsy* pastry from nutritional, cultural, and ecological perspectives. Another aim is to assess the cultural impact of *lörtsy* among Finns from Eastern Finland by conducting a short electronical survey. In addition, the final aim is to develop a modified version of the pastry, especially by paying attention to the properties observed in the analysis, i.e. the nutritional value, nature footprint, and cultural impact. The development of the new recipe is briefly explained. This introduction discusses the history of Finnish food culture and the place *lörtsy* holds in it.

1.1. Food Culture Review

Finland is the northernmost agricultural country in the world (Ruokatieto, 2025). This geographical location has strongly influenced the emergence and development of Finnish food culture which has traditionally been divided into

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eastern, western, and northern culinary regions (Peda.net, n.d). In the Western Finland, food was usually cooked by boiling, and the dry sour bread was baked only a few times a year (Ruokatieto, 2025). Influences from Western Finnish food culture include salting fish and beer and cheese making. In Western Finland, many common dishes are shared with Sweden, for example, pea (*Lathyrus oleraceus* L.) soup, oven baked pancake, meatballs and shrove buns. In the Eastern parts of Finland, fermentation was a typical method of preservation, and major influences came from the Slavic food culture and Russia (Peda.net, n.d).

Daily use of the bread oven enabled the emergence of a tradition of various pies. Eastern Finland is especially famous for its Karelian stew and pies, but the food tradition includes also fish and swede (rutabaga) pies, different types of casseroles, sour dough bread, mushroom dishes and curds. In the Northern Finland, food culture has been shaped by the location and the limits set by the cool climate; preserving roots, meat and fish have been preconditions to survival. In the Southern Finland, the continuous flow of migration from other parts of Finland has brought diverse influences from the food culture of other provinces to the region and, on the other hand, foreign innovations have arrived elsewhere in the country via the capital of Finland (Ruokatieto, 2025).

Nowadays, the small local businesses are the ones that maintain and build up the locality and diversity of Finnish food culture (Ruokatieto, 2025). Even if preparation methods and people's taste habits have leveled over time, each region still has its own specialties, typically a local bread or seasonal and festive dishes.

1.2. Lörtsy: a delicacy from Savonlinna

Lörtsy is a wheat-dough-crust, half-disk-shaped closed meat pie that is consumed warm (Turtia, 2009). It's a regional pastry from Savonlinna, a town in South Savo, in Eastern Finland. *Lörtsy* embodies the local food culture and illustrates

how small-scale regional foods enrich cultural and culinary diversity in Finland.

First mentions of *lörtsy* and similar pastries are from the 1950s (Liukkonen, 2014). At least two bakeries have been known to sell *lörtsy*-like pastries during that time. One was the family bakery of Sulo-Veikko Strömberg and Fanny Strömberg. They made their product in the bakery located on the ground floor of their family home and sold them to local markets and grills.

The product was not sold with the name *lörtsy* at this time. The name is thought to have originated amongst the youth in the 1960s (Liukkonen, 2014). *Lörtsy* is thin, and when heated, it becomes soft and slack (Finnish: *löysä*) and word *lörtsy* came from this attribute. One of the young people using the name *lörtsy*, became a baker as an adult and decided to make a sweet version of his childhood treat, and so an apple jam filled *omenälörtsy* was created (apple *lörtsy*) (Rossi, 2020). Proper commercial usage of the name started in 1984 by market salesman Jukka Huopainen, and the product became increasingly popular after that (Rossi, 2020).

These days, five different bakeries and around 20 to 30 people make *lörtsys* in the Savonlinna area. An estimated 100,000 pieces are sold every year (Liukkonen, 2014). Every bakery has their own recipe for the dough and the filling (Hänninen, 2002).

All five Savonlinna bakeries applied for European Union Protected geographical indication (PGI) for *lörtsy* (Tynkkynen, 2024). To qualify for PGI, at least one of the following phases must take place within a certain geographical area: production, processing, or handling (Finnish Food Authority, 2021). Quality, reputation, or other characteristics of the product must be attributed to the area. In the case of PGI, some of the raw materials used for production can be sourced from other areas. Two other Finnish products already have this designation: *Kainuun rönttönen* - a rye crust pie with lingonberries-, and *puruveden muikku* – vendace caught in Lake Puruvesi.

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1.3. Nutritional assessment

According to the Finnish nutritional recommendations, there are a few parts of the diet that have the most room for improvement among Finns: too low intake of fiber and too high intake of salt and saturated fats (National Nutrition Council and Finnish Institute for Health and Welfare, 2024). Therefore, this report will focus mainly on these nutrients when assessing the nutritional profile of the original *lörtsy*. In addition to the ingredients of the original *lörtsy*, the cooking method will also be briefly assessed based on its effect on the nutritional value of the product. The aim is to identify the overall nutritional profile of *lörtsy* in order to choose how the recipe could be modified to improve its nutritional value.

1.4. Biodiversity and nature footprint of *lörtsy*

Biodiversity is traditionally defined as the variety of life on Earth in all its forms (European Parliament, 2020). It comprises the number of species, their genetic variation, and the interaction of these lifeforms within complex ecosystems. Since living organisms interact in dynamic ecosystems, the disappearance of one species can have a far-reaching impact on the food chain. The nature footprint describes the overall impact of an individual, organization, product, or service on biodiversity, including, for example, the pressures caused by resource use, land use, emissions, and other activities that contribute to the degradation of biodiversity (Sitra, n.d.). The nature footprint describes the impact of human activity on some aspects of our environment (Miettinen, 2024). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has identified five main direct drivers of biodiversity loss (Table 1). In this article, the nature footprint is expressed as PDN-year, or Potentially Disappeared Number of species per year. The indicator is derived from PDF-year, or Potentially Disappeared Fraction of species, and represents the potential long-term

Table 1. Drivers of biodiversity loss.

Factor	Causes
Land-use change	Fragmentation, degradation and loss of ecosystem
Greenhouse gas emissions	Climate warming, which alters the functioning of ecosystem
Pollutants	Covers other key emissions and adversely affect ecosystems
The direct exploitation of natural resources	Leads to the depletion of living and non-living natural resources
The spread of invasive species	Alters the functioning of ecosystems

contribution of producing one kilogram of a product to global species loss. (Miettinen, 2024; Veerappa *et al.*, 2026). Another measure used in nature footprint assessments is the biodiversity equivalent (BDe), which describes the combined proportion across ecosystem types of all Earth's species that are likely to go extinct due to activities that cause environmental harm (Geneidy *et al.*, 2025). No single calculation method can yet capture all five drivers, but currently the best available methods cover three or four out of the five (Miettinen, 2024). Finnish Innovation Fund Sitra, Jyväskylä University and Nokia announced a joint effort to develop the calculation of nature footprints towards a common international standard. LUT University is already helping to develop the Finnish calculation method in close cooperation with the University of Jyväskylä.

2. Multidisciplinary analysis of *lörtsy*

2.1 Nutritional evaluation of *lörtsy*

To evaluate the nutritional quality of *lörtsy*, we chose the recipes of three different manufacturers of *lörtsy* to represent the original recipe for further inspection: Leipomo Laurikainen (LL), Lörtsypoijat (LP) and

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HoviRuoka (HR). The ingredients used in the making of the product are listed in Table 2. All three manufacturers' *lörtsys* contained the same main ingredients: wheat flour, rice and ground beef meat. Only the recipe of HR contained food additives (EFSA Panel on Food Additives and Nutrient Sources added to Food (ANS), 2015; 2017; 2018a; 2018b; EFSA Panel on Food Additives and Flavourings (FAF), 2019) and bread improver (E 472e, mono- and diacetyl tartaric acid esters of mono- and diglycerides of fatty acids) (EFSA Panel on Food Additives and Flavourings (FAF), 2025). This is probably due to the different sales purposes of the *lörtsys*, meaning that whereas HR makes *lörtsys* for retail stores to sell as ready-made products that need to have a longer shelf life, the two other bakeries make *lörtsys* for being sold fresh at markets. (HoviRuoka, n.d.; Leipomo Laurikainen, n.d.; Lörtsy-pojat, n.d.)

The nutritional contents of the *lörtsys* are shown in Table 3. The nutritional contents of the *lörtsys* made by LP and HR are quite similar, but there is a slight difference between those and the *lörtsys* made by LL. The fat and salt content are higher in the recipes of LP and HR. The Finnish Heart Symbol indicates nutritionally better choices within a product category, especially regarding fat quality, salt, sugar, and dietary fiber. However, according to its criteria, these recipes do not qualify as lower-salt savory pastries, as their salt content exceeds the maximum limit of 1.0 g / 100 g, or as lower-fat savory pastries, as their fat content exceeds the maximum limit of 5.0 g / 100 g (The Heart Symbol, n.d.). The amount of saturated fats was only available for HR's recipe, and it did not meet the recommendations, being 36% of total fats (max 30 % of all fats). Ground beef used in all of these recipes is usually a source of saturated fats, even though the recipe of LL contains low-fat ground beef. The main source of fat used in all the recipes is canola oil or rapeseed oil, which contains a lot (> 90 %) of unsaturated fats (Finnish Institute for Health and Welfare, n.d.). The amount of dietary fiber was not available, so

Table 2. The ingredients used in the three different recipes of lörtsy.

Ingredient	Leipomo Laurikainen	Lörtsy-pojat	Hovi-Ruoka
Wheat flour	x	x	x
Rice	x	x	x
Ground beef	x (low-fat)	x	x
Soy protein	x	-	x
Salt	x	x	x
Other seasonings	x	x	x
Sugar	x	x	x
Canola oil / Rapeseed oil	x	x	x
Additives (E-codes)	-	-	x
Bread improver	-	-	x

Table 3. Nutritional contents of the Finnish lörtsy (per 100 g) by three different manufacturers.

Nutritional content	Leipomo Laurikainen	Lörtsy-pojat	Hovi-Ruoka
Energy (kJ)	1503	1025	1008
Energy (kcal)	313	245	241
Fats (g)	5	9.3	8.9
Carbohydrates (g)	61	33.8	31.3
Protein (g)	11	6.4	8.1
Salt (g)	0.015	1.2	1.9

that could not be compared with the Finnish nutritional recommendations or the criteria of the Heart Symbol. However, as all the ingredients were stated, knowing that all the recipes contained white wheat flour and rice, we can assume that the fiber content was probably below the Finnish Heart Symbol criteria for high-fiber in the category of savory pastries (> 2.0 g in the finished product) (The Heart Symbol, n.d.), since the total dietary fiber content of each

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ingredient is < 5 g (Finnish Institute for Health and Welfare, n.d.).

The cooking method used in the making of traditional *lörtsy* is deep-frying. This method increases the fat content and energy density of the product. The amount of saturated and unsaturated fatty acid types may change during the cooking process (by e.g. oxidation, hydrolysis, isomerisation and polymerisation) (Brühl, 2014). In addition, deep frying may add carcinogenic compounds, such as carbonyl compounds, monoepoxides, or aldehydes, to the food product. However, the formation of these harmful compounds depends on the type of oil used in the cooking process (Dangal *et al.*, 2024).

Overall, a traditional *lörtsy* is a food product that is moderately low in dietary fiber and high in salt and saturated fats. The cooking method has also room for improvement from a nutritional perspective.

2.2. Ecological evaluation of traditional *lörtsy* ingredients

Agricultural expansion is the dominant driver of global deforestation, particularly in the tropics, where it accounts for approximately 90 % or more of forest loss (Pendrill *et al.*, 2022). Permanent agriculture alone has been estimated to cause about 35 % of global tree-cover loss (Sims *et al.*, 2025). Approximately 45 % of the world's habitable land is used for agriculture, of which about 80% is used for livestock grazing and animal feed production, and 16 % is used to grow food for direct human consumption (Ritchie and Roser, 2019).

Meat production, and especially beef production, require significant amounts of land to grow their feed needs and emit a substantial amount of greenhouse gasses (Järviö and Uusitalo, 2024). 25 % of global land use, land-use changes, and forestry emissions are driven by beef production (WWF, 2026). Livestock production accounts for 14–18 % of global greenhouse gas emissions, including 32 % of methane gas emissions worldwide (Stanford University, 2025). Current intensive meat production systems can cause

substantial biodiversity loss, particularly when livestock production or feed cultivation occurs in species-rich regions, such as Brazil or Colombia. Consumption needs to decrease so that climate change and further degradation of our life-supporting ecosystems can be mitigated (Järviö and Uusitalo, 2024).

Rice cultivation is a significant contributor to anthropogenic methane emissions, accounting for approximately 10–12 % of global human-induced methane output (Sulaiman and Salim, 2026). It is primarily emitted during traditional rice farming practices, where fields are flooded with water, creating anaerobic conditions that promote methane production by methanogenic archaea (Nikolaisen *et al.*, 2021, Zhan *et al.*, 2016). Globally, rice farming accounts for 34–43 % of all irrigation water use, highlighting its substantial demand for freshwater resources (Surendran *et al.*, 2021). Asia dominates rice cultivation, accounting for about 89–90 % of the world's rice-growing area (Ohan, 2012). According to Veerappa *et al.* (2026), the biodiversity impact of dried wheat produced in Finland is only 16 % of that of dried rice produced in Italy. Wheat generally requires less irrigation water than rice; a kilogram of paddy rice requires 2,500 L of water to grow, while a kilogram of wheat requires 1,000 L of water (Surendran *et al.*, 2021, Kandhro *et al.*, 2026).

3. Materials and methods

3.1 Planning of a new *lörtsy* recipe

The objective of this study is to decrease the nature footprint of *lörtsy* and improve the product's nutritional quality. Traditionally, *lörtsy* is prepared by deep-frying, a method known to significantly increase the fat content and energy density of the final product. To reduce these effects, alternative cooking methods such as baking, pan-frying, or using an air fryer were proposed.

White wheat flour in the dough was decided to be partially replaced with whole grain flour to

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Table 4. Nutritional content for the selected ingredients of the new recipe.

Nutritional content per 100 g	Wheat flour	Whole grain wheat flour	Oat	Textured soy protein
Energy (kJ)	1481.7	1498	1527.7	704
Energy (kcal)	354	358	365	168
Fats (g)	2.5	2.5	7.2	8.0
Carbohydrates (g)	70	63.8	60	4.6
Protein (g)	12	13	14	16.1
Salt (g)	-	-	-	-
Fiber (g)	3.5	9.9	11	7.1

increase the fiber content so that the final product would contain > 2 g of fiber, making it high in fiber based on the Finnish Heart Symbol criteria for this type of product (The Heart Symbol, n.d). Instead of conventional rice-beef filling, it was decided to use an oat-soy protein filling due to its lower environmental impacts. Oats were selected to replace rice because they are locally available in Finland and have a substantially lower biodiversity impact than rice (Veerappa *et al.*, 2026). Meat was replaced with textured soy protein as a plant-based protein source. Although the soy product used is imported from Croatia, as soybean cultivation remains limited in Finland largely due to climatic constraints, its biodiversity impact is considerably lower than that of Finnish beef (Veerappa *et al.*, 2026; Yle 2020). Nutritional contents of the selected ingredients are listed in Table 4.

Wheat flour is predominantly composed of carbohydrates (70 %), mainly in the form of starch, with minor contributions from simple sugars (0.4 %) (Hurri-Martikainen, 2017). Proteins account for approximately 13 % of wheat's dry weight.

Seeds of oat (*Avena sativa*) are rich in dietary fibers (10 g / 100 g), particularly beta glucans, and consumption of oat has been linked to reduced blood cholesterol, moderated postprandial

glucose response, and improved gastrointestinal health (EFSA, 2009; Laine & Savela, 2020). Oat also contains 13.6 –14 g of protein and 7.2 g of fat per 100 g. Carbohydrates, mainly starch, make up 60 % of oat dry weight.

The seeds of soybean (*Glycine max*) are used both for human consumption and as animal feed (Pelander, 2023). It's an excellent food source as it contains high-quality protein (40 %), a high ratio of unsaturated fatty acids, and dietary fiber (Kim *et al.*, 2021). The seed of soybean comprises lipids (18 %), proteins (38 %), carbohydrates (30 %), and moisture, ash, and other substances (14 %), which include vitamins and minerals.

3.2 Manufacturing process of the new lörtsy

The study focused on substituting refined wheat flour with whole grain flour and evaluating the resulting changes in fiber content, texture, and taste. Two dough variants were prepared with 10 % and 30 % whole grain flour content, and the ingredients are listed in Table 5.

Dough A: 10 % whole grain flour of total flour weight.

Dough B: 30 % whole grain flour of total flour weight

The base recipe was adapted from a meat pie formulation suitable for experimental kitchen use (Kinuskikissa, 2020). Traditional meat and rice fillings were replaced with plant-based alternatives (Table 6).

Table 5. Recipes of the doughs

Ingredients (Dough)	10 % dough	30 % dough
Water	2.5 dl	2.5 dl
Yeast	12.5 g	12.5 g
Salt	5 g	5 g
Sugar	5 g	5 g
Rapeseed oil	25 g	25 g
Wheat flour	4.5 dl	3 dl
Whole grain wheat flour	0.5 dl	1.65 dl

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Table 6. The list of ingredients of lörtsy's fillings.

Fillings
1 onion
5 g garlic
2 ¼ dl oat grain
1 dl textured soy protein (filling 1)
225 g textured fava beans (filling 2)
15 g nutritional yeast
5 g soy sauce, pepper, paprika, chili
100 g carrot and cabbage

Preparation method:

1. Fresh baker's yeast (*Saccharomyces cerevisiae*) was dissolved in lukewarm water maintained at 37 °C and allowed to activate under low stirring.
2. Wheat flour was gradually incorporated into the yeast solution, followed by the addition of the remaining ingredients. Mixing continued until a homogeneous dough was obtained.
3. Dough A was proofed under controlled conditions until adequate fermentation was achieved.
4. After proofing, the dough was divided into four equal portions. Each portion was rolled to a uniform thickness of 1 cm.
5. Circular dough disks (30 cm diameter) were cut using a pot lid as a mold.
6. Two dough disks were filled with an oat-soy mixture. The remaining two were filled with an oat-fava bean mixture.
7. Each filled disk was folded in half and sealed along the edges using a fork to ensure closure.
8. Instead of deep frying, the shaped pastries were lightly brushed with canola oil and baked in a preheated oven at 225 °C for 15 minutes.
9. After baking, the pastries were transferred to a steamer pot and steamed for 12 minutes to achieve the characteristic soft texture.
10. The same process was repeated for Dough B, formulated with 30% whole grain flour, using

identical dough mass, processing temperatures, and cooking times.

3.3 Tasting the new product

For tasting the new lörtsy recipe, the authors evaluated the consistency, visual appearance, and general pleasantness of the products. The evaluation was non-blinded, informal, and concluded only by the authors and supervisors.

3.4 Cultural impact survey

To effectively assess the cultural impact of lörtsy among Savonlinna locals, a short and targeted survey was created and conducted (Appendix 1). The survey was completely anonymous. The following questions were asked:

1. How often do you consume lörtsys or other meat pies?
2. Describe when and in what situations do you consume lörtsys?
3. Do you eat lörtsys savory or sweet?
4. Which one do you prefer?
5. What is your favorite filling?
6. Tell us your best lörtsy memories and experiences.
7. Which Finnish town produces the best lörtsys or meat pies?

This survey combined the basic information about their favorite toppings and fillings. To understand the cultural significance of this product, we asked for specific memories and stories involving lörtsy using open-ended questions. Similar concepts and themes containing the same keywords were identified and compiled from the submitted stories.

3.5 Calculations

To evaluate the nutritional improvements of lörtsy, the fat and fiber contents of the original ingredients and our substitutes were compared using the nutrition values obtained

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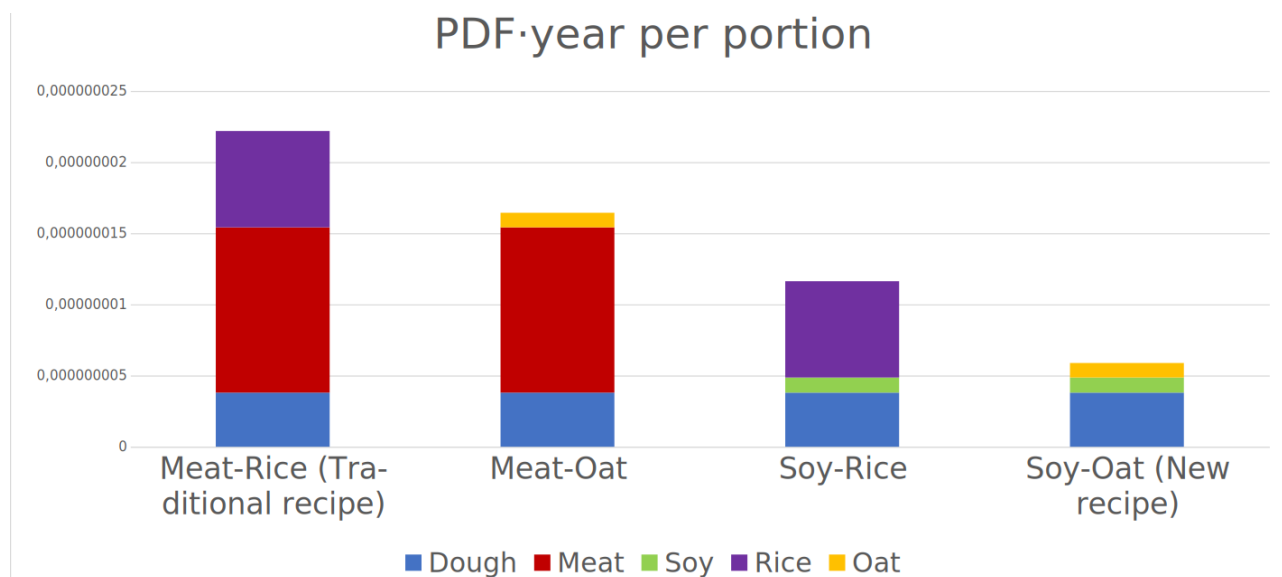


Figure 1. Biodiversity impact of a plant-based lörtsy in comparison to a theoretical beef-rice version before frying. Spices are not included in the calculations. PDN.year expresses the potential long-term contribution to global species loss associated, with producing one kilogram of a product.

from Fineli, a national Food Composition Database (Finnish Institute for Health and Welfare, n.d.). The nature footprints of the plant-based innovations and the original *lörtsy* were calculated by combining the nature footprint values of their raw materials (excluding spices). The raw material-specific nature footprint values were based on the life cycle assessment (LCA) calculations reported by Veerappa *et al.* (2026). The calculation included only the raw material composition of each product; cooking, frying, preparation, and other use-phase processes were excluded.

4. Results

4.1. Tasting of the new lörtsy

After tasting the new version of *lörtsy*, the authors found the consistency and flavour of the filling with textured soy protein to be more similar to the original *lörtsy* and better suitable for this type of product compared to the filling made with fava beans. Therefore, it was decided that only the soy

filling version of the product would be included for other assessments.

4.2. Biodiversity footprint calculations

For biodiversity footprint calculations, the chosen item was a *lörtsy* filled with a soy-oat mixture, in which 30 % of the refined wheat flour was substituted with whole grain flour. The calculations were based on the assumption that the original *lörtsy* was deep-fried.

Different versions of the *lörtsy* and proportion of its ingredients in the nature footprint are listed in Figure 1. Calculations show that by switching meat and rice to oat and soy, the nature footprint of the plant based *lörtsy* decreased by 73 %. Figure 1 also illustrates the potential environmental impacts of other possible variations of *lörtsy*. Simply replacing rice with oats would reduce the nature footprint of *lörtsy* by 26 %, while replacing meat with soy would reduce it by 48 % compared to the original one. It should be noted that these results are only estimates, because the nature footprint of all the

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recipe's ingredients was not known. In addition, the biodiversity impact of *lörtsy* depends strongly on the countries of origin of the raw materials. In this calculation, the raw materials were assumed to be mainly of Finnish origin, with the exception of textured soy protein and rice, which were assumed to originate from Croatia (textured soy protein) and Italy (rice).

4.3. Nutritional comparisons

The fiber content of both our alternative grain products (oat grains and whole grain wheat flour) was 94 % and 64 % higher than the fiber contents of the original ingredients (rice and refined wheat flour) (Figure 2 A). The total fat content and the portion of saturated fats was 96 % lower in the replacing ingredients of the filling (textured soy protein) compared to the filling ingredients of the original product (ground beef) (Figure 2 B). The substitution of whole grain flour affected dough elasticity and handling. The 30 % whole grain dough was firmer and less extensible, requiring more effort during rolling. The final products showed differences in crust hardness and internal texture. Steaming effectively softened the crust, restoring the traditional *lörtsy* mouthfeel, based on the authors' sensory observations.

4.4. Assessment of cultural impact

30 people answered the survey. According to the survey conducted, the places *lörtsy* were associated with were the marketplace ($n = 14$), Savonlinna ($n = 8$) and cottage ($n = 1$) (Figure 3). As of all the times of the year, summer was associated with *lörtsy* consumption the most, as it was mentioned 10 times by the respondents. The product is enjoyed as a lunch item, a snack, or a treat, either at the forementioned marketplace, parties, events, or trips.

Combined 19 answers of memories of *lörtsy* were given, and of these, ten answers were associated with summer and eight with childhood (Figure 4). The product was consumed with friends and

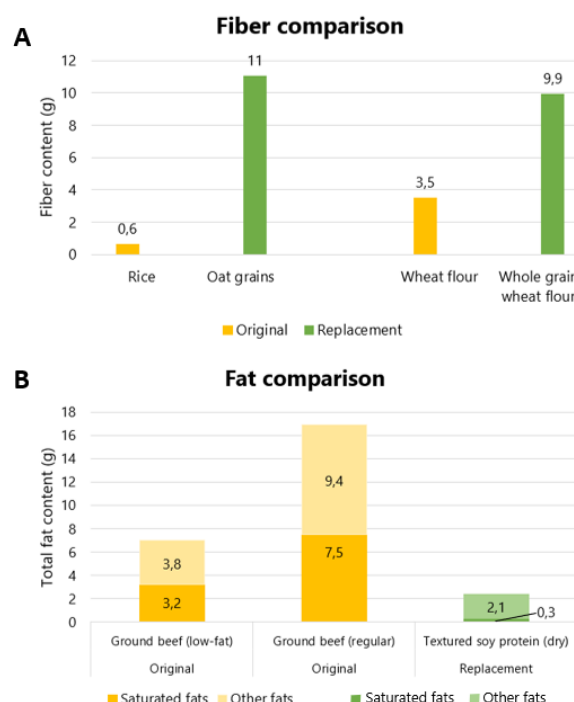


Figure 2. Comparison of the fiber and fat contents of the original and substitute ingredients. Nutrition values were obtained from the national Food Composition Database, Fineli (Finnish Institute for Health and Welfare, n.d.).

family, based on answers detailing childhood memories and events as places of *lörtsy* consuming. The memories and associations linked to *lörtsy* were all positive. One example of the answers encapsulates the common tone of the answers: "On a summer day, a fresh and warm *lörtsy* bought from a kiosk, and eating outside."

5. Discussion

5.1 Nutritional improvements

Nutritionally, the whole grain reformulations of *lörtsy* offered increased fiber content, aligning with current dietary recommendations for fiber

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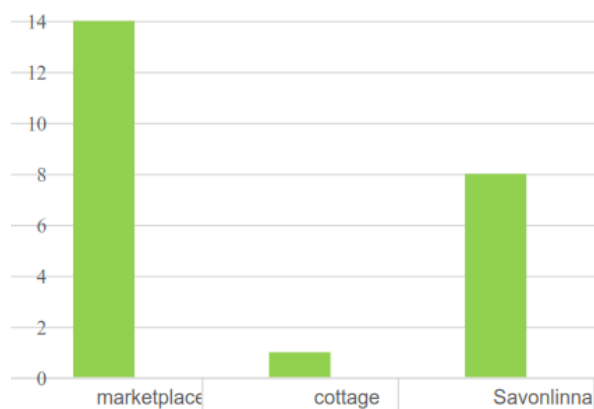


Figure 3. Mentions of keywords (places) associated with lörtsy.

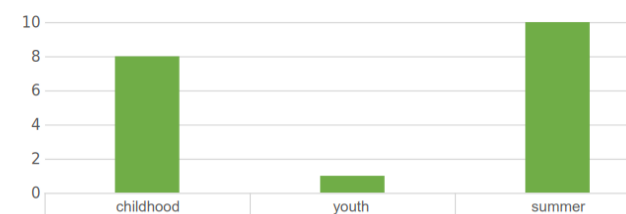


Figure 4. Mentions of keywords describing memories and period associated with lörtsy.

intake. Whole grain flour substitution in *lörtsy* dough formulations is feasible and beneficial for enhancing nutritional value. By replacing ground beef with soy protein, a better fat profile was achieved without causing a too distinguishable change in the texture of the filling. The modified baking and steaming process supports the development of a healthier version of traditional *lörtsy* pastry.

These nutritional improvements to *lörtsy* might have a small impact on the health of an individual, especially considering that many people report that they consume the product quite randomly and perhaps on special occasions, for example as a summer day snack. However, consuming snack products instead of main meals has become more popular among Finns in the 2000s (33 % in the 1990s vs 36–40 % in 2000s). Snack products usually have a higher energy density than main meals (Ovaskainen *et al.*, 2006). As can be seen

in other European countries; by doing collaborative work to increase the consumption of whole grains and therefore fiber, a positive change can be seen at a national level (Boyle *et al.*, 2023). Previous evidence shows that different food product reformulations can lead to even a 5.1 % reduction of salt intake (Jaenke *et al.*, 2017), reduction of body weight by 1 kg (Hashem *et al.*, 2016) or a decreased intake of trans fatty acids by an effect size of -1.2 (Gressier *et al.*, 2021). This suggests that our modifications to the recipe of *lörtsy* might also have an impact on the public health of Finns, but to be able to accurately evaluate the possible impact of this kind of a reformulation, the true amount of *lörtsy* consumption in Finland should be further investigated.

5.2. Cultural impact

Answers to the questionnaire pinpointed *lörtsy* as a regional and very local delicacy. Unique local specialties are linked to the local culture and history (Björk and Kauppinen-Räsänen, 2016). This kind of delicacy is an inherent feature of the socioeconomic system of the area. *Lörtsy* is usually consumed as a summertime snack item. The presence of *lörtsy* in the city life of Savonlinna makes it a potential attraction to tourists and locals alike. Peripheral areas must use these delicacies as attractions and part of their identity (Björk and Kauppinen, 2016). This way the product can keep its place as an important part of the local culture. Modifying the recipe to increase health benefits and ecological sustainability gives *lörtsy* more tools to keep its significance.

When selecting ingredients and preparation methods, it is essential to consider the cultural and emotional significance of food in everyday life. Factors such as taste preferences, the context of consumption (weekday vs. weekend), and the perceived value of maintaining or altering traditional preparation methods must be considered to ensure consumer acceptance and long-term sustainability.

5.3. Environmental impact

Both ground meat and rice are associated with relatively high biodiversity impacts; therefore, these components were prioritized for replacement. From both environmental and nutritional perspectives, domestic vegetables were proposed as alternatives to ground meat, potentially offering ecological and health benefits. The results indicate that the ingredients in the filling can be replaced with alternative options to reduce the environmental impact while improving the nutritional quality of the product. Even relatively small modifications to the original recipe may therefore contribute to more sustainable food choices.

6. Conclusions

Nature footprint calculations show that making small changes to an existing recipe can positively affect the footprint of the product. Continuation of product development of the new *lörtsy* recipe would include a conclusive consumer sensory study to gauge the public acceptance of the new product variable. In addition to this consumer study, a creation of *lörtsy* sensory profile could be created by doing a trained panel sensory study. Due to existing variability of the product, receptiveness for a new version could be high.

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Appendix 1. Lörtsy and meat pie questionnaire

1. Do you eat meat pies or *lörtsy* (any filling, also vegetarian)?
 - a. Daily
 - b. Few times a week
 - c. Weekly
 - d. Once or twice a month
 - e. Once a year
 - f. More rarely
 - g. Never
2. In your own words describe the situations you consume meat pie or *lörtsy*. Either savor or sweet.
3. Have you eaten *lörtsy* either savor or sweet?
 - a. Both
 - b. Savor
 - c. Sweet
 - d. Neither
4. Which form of *lörtsy*, savor or sweet do you prefer?
 - a. Savor
 - b. Sweet
 - c. Neither

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5. What is your favorite meat pie or *lörtsy* filling?
6. Tell your best *lörtsy* or meat pie stories and memories. Both your own and ones heard from a friend.
7. In your opinion, where are the best meat pies in Finland in your opinion?

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