



Sámi Traditional Knowledge of Reindeer Meat Smoking

Kia Krarup Hansen^{1,2} · Ravnna Biret Marja E. Sara^{1,2,3}  · Inger Anita Smuk² · Camilla Brattland⁴

Accepted: 26 May 2022
© The Author(s) 2022

Abstract

Reindeer meat, traditional food and knowledge are vital for the culture, health, and economy of Sámi reindeer herders. Nevertheless, the practices of reindeer meat smoking have barely been part of scientific research or reindeer herding management. We investigated Sámi reindeer herders' approach to meat smoking in Northern Norway performed in the traditional Sámi tent, the *lávvu*. The investigation included workshops, interviews, participatory observations, and co-analyze meetings. Our findings reveal a typology of the traditional Sámi smoking practices. Sámi reindeer herders use a variety of wood species and plant parts to control the smoke based on a complex system of traditional knowledge. Yet there is a need for education, industry, and research acknowledging, supporting, and maintaining the Sámi meat-smoking process and associated worldviews, knowledge, and practices to ensure ethical, sustainable, and healthy food production.

Keywords Food preservation · Meat smoking · Traditional knowledge · Reindeer herding

Introduction

Sámi reindeer herders continue to migrate with their livestock between seasonal pastures in Northern Norway today. One of the ways to preserve meat during long migrations is smoking:

“I ran to find the best piece of reindeer meat in the bottom of my dad’s backpack when he came back [from the mountains herding reindeer in summer]. He had carried the meat with him for weeks, smoking it on a stick nearby the fireplace at each stop. This, now small piece of smoked reindeer meat, was so tender and tasty.” (Smuk, I.A., Personal communication).

✉ Ravnna Biret Marja E. Sara
ravdnabme@gmail.com; ravdnabmes@samas.no

¹ Department of Social Science, University of Tromsø–The Arctic University of Norway, Tromsø, Norway

² UArctic EALÁT Institute at International Centre for Reindeer Husbandry, Kautokeino, Norway

³ Sámi University of Applied Sciences, Kautokeino, Norway

⁴ The Arctic University Museum of Norway, Tromsø, Norway

Globally, environmental and social changes alter Indigenous Peoples traditional food systems, threaten their continuity (Kuhnlein 2009; FAO 2009), and locally affect Sámi reindeer herders eating patterns and health (Sara et al. 2022). Leading scientists in human health, agriculture, political sciences, and environmental sustainability argue that contemporary food production, food security, and food consumption is unsustainable, often unhealthy, and wasteful. Transition to sustainable and healthy food systems would warrant the achievement of the UN Sustainable Development Goals (SDGs) and the Paris Agreement. The EAT-Lancet Commissions, for example, suggest a reduction in red meat consumption, but they also state that the needed changes differ greatly by region (Willett et al. 2019). The UN Food and Agriculture Organization (FAO 2009) suggests that traditional food cultures can guide a more ethical and sustainable future food production. Therefore, traditional food knowledge needs to be documented and maintained (Kuhnlein 2009).

The White/Wiphala Paper (FAO 2021) on Indigenous Peoples' Food Systems provides examples of sustainable Indigenous Peoples' food systems worldwide. While the paper has contributions from Indigenous Inuit peoples, it does not contain contributions from other Arctic and sub-Arctic reindeer herding peoples, such as the Sámi. This despite recent interest in reindeer herding food traditions and culinary diet, i.e. Burgess (2018). Thus, little is known about what food ethics and sustainability entails in a Sámi context, which includes smoked reindeer meat as an important food source (Krarup Hansen et al. 2022). Our paper addresses this knowledge gap through the example of Sámi meat smoking practices and traditional knowledge.

Sustaining ethical traditional meat smoking as part of Sámi culture is a challenge, since also traditional practices have to adapt to global changes and modern demands for food sustainability, food security, and food safety. For example, at the beginning of the 2000s, the Sámi reindeer herders wanted to create a more sustainable and independent family-based reindeer herding economy (Riddervold 2002; Smuk 2003). To achieve increased economic value and to meet the local demand, the Sámi herders family aimed to produce and sell traditional *lávvu*-smoked reindeer meat. For this, the herders family needed approval from *Mattilsynet*, the Norwegian Food Safety Authority (NFSA). The NFSA questioned the reindeer herders' knowledge and ability to meet public meat quality and health standards. To approve their products for public sale the reindeer herders started to document their traditional smoking methods (Riddervold 2002; Smuk 2003). Yet, almost 20 years later, the Sámi traditional smoking practice is still not documented scientifically (Krarup Hansen et al. 2020).

Reindeer husbandry is looking for ways to improve their traditional economies. Economic value drives the need to document traditional knowledge of meat smoking processes. Traditional smoking of meat is practiced by many reindeer herding groups across the circumpolar North, but their similarities and variations are marginally documented in science (Krarup Hansen et al. 2020).

This paper documents the commonalities and main varieties of a specific example of Arctic Indigenous reindeer peoples' traditional food practice from Northern Norway — Sámi *lávvu*-smoking. Compared to general definitions of traditional knowledge, we explore the content, extent, and scope of Sámi-*lávvu* smoking, and discuss how it can contribute to food ethics and food sustainability. In particular, we articulate the question: how to ensure continued transmission of Sámi traditional knowledge of *lávvu*-smoking to future generations and practitioners in times of change?

Theoretical Background

The theoretical framework for the paper includes traditional knowledge in the context of Sámi food smoking, food sustainability, food ethics, and Indigenous Peoples' food systems.

Traditional Knowledge of Reindeer Herders

Traditional knowledge is most often (as reviewed by Davis and Ruddle 2010) referred to as a shared system of “knowledge, practice and belief” developed through direct experience within a specific physical setting and “handed down through generations” (Berkes et al. 2000: 1252). The Ottawa Traditional Knowledge Principles define traditional knowledge as “a systematic way of thinking and knowing, generated through cultural practices, lived experiences, lessons and skills” (Arctic Council 2015: 1). The White/Wiphala paper refers to Indigenous Peoples' traditional knowledge as a “cumulative body of knowledge, practices and manifestations maintained and developed by Indigenous Peoples with long histories of interaction with their natural environment” (FAO 2021: x).

Berkes (1999) describes *traditional knowledge*, *traditional ecological knowledge* (TEK), *indigenous knowledge*, and *local knowledge* as related concepts. All of these concepts may apply to the Sámi reindeer herders' knowledge and practices of reindeer meat smoking, but for consistency to describe their knowledge, this paper operates with the term *traditional knowledge*. ‘Traditional’ is often misinterpreted as old. Yet it does not refer to the antiquity of the knowledge, but to its acquisition and usage (Battiste and Henderson 2000: 46). Traditional knowledge derives from both old and new experiences, and it alters with local conditions and thus includes *local knowledge*. However, it is important to be aware that being traditional, local, or Indigenous is not itself a guarantee of the virtue of the knowledge (Berkes 1999).

Researchers claim that traditional knowledge—in contrast to scientific knowledge—is holistic (Nakashima and Roue 2002), embedded in “a complex web of practices, values, and social relations” (Nadasdy 1999: 6), and dynamic by being adaptable to environmental changes and by incorporating social processes such as exploitation of local resources (Peloquin and Berkes 2009). Berkes (1999) exemplifies the differences in traditional knowledge and western science, with a case on Cree caribou hunters (Ch. 6), and argues that the traditional knowledge system, unlike scientific knowledge system, neither produces nor uses quantitative measures. Instead, traditional knowledge holders use qualitative mental models or rules-of-thumb (Berkes 1999, Ch. 6 & 9), and fuzzy logic (Berkes and Berkes 2009).

For example, when Sámi reindeer herders assess and measure reindeer meat quality, they express the quality through a fuzzy logic understanding using linguistic variables with an approximately quantification, not specific numbers (Sara and Eira 2021). Further, Nordin-Jonsson (2010) defines Sámi traditional knowledge as a dynamic knowledge linked to geographical areas and ecological niches (traditional and local ecological knowledge), verbally transmitted from generation to generation and with a holistic perspective. Guttorm (2011) distinguishes between embodied knowledge or skills (in Sámi *máhttu*)—having knowledge in something—and theoretical knowledge (*diehtu*)—having knowledge about something.

Several empirical studies of traditional Sámi knowledge have examined the role of traditional knowledge in Sámi reindeer husbandry, and found it important for evaluating snow cover (Eira et al. 2013), herding organization (Sara 2009), reindeer

governance (Johnsen et al. 2017; Turi 2016), nomadic slaughtering and reindeer meat quality assessment (Sara and Eira 2021; Sara et al. 2022) and herders' ability to self-organize and build resilience to climate change (Reinert et al. 2009).

Ethical Sustainable Indigenous Food Systems

Indigenous Peoples frame their food systems within local food accessible from farming or wild harvesting based on traditional knowledge (Lugo-Morin 2020; Kuhnlein 2009). Our paper focuses on a specific Sámi food system in Northern Norway. Green (2017, ch. 6) studied another, but in many ways similar, Sámi cuisine in Northern Sweden and concluded that the Sámi cuisine and food patterns remain unrestricted. Nevertheless, Green highlights 1) that family and regional traditions differ, 2) that market-oriented products differ from home-made ones, and 3) that producers often focus on reindeer meat—in particular smoked reindeer meat (ibid). Since smoked meat is already a popular and preferred food among consumers in the Nordic countries, ensuring food ethics and sustainability of Sámi food production systems is essential.

In Arctic Canada and Alaska, there has been a particular focus on Indigenous food systems (Settee and Shukla 2020; Council of Canadian Academies 2014; ICC-AK 2015). The EAT-Lancet Commissions defined *food systems* as “[a]ll elements and activities that relate to production, processing, distribution, preparation, and consumption of food” (Willett et al. 2019: 4). The holistic and divine worldview of food has changed alongside personal, social, environmental, political, and economic changes. It has impacted human health and well-being (Settee and Shukla 2020). The Alaskan Inuit and northern Canadian Indigenous populations see food security based on their Indigenous holistic worldview as an instrument to overcome these changes (Council of Canadian Academies 2014; ICC-AK 2015). *Food security* “exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life” (FAO 2006).

Indigenous Peoples conceptualize ‘sustainability’ through the following core multidimensional elements: Context-based relationality; community-based governance; education; language; quality of life and health; and communal recognition of certain nonhumans as life-givers (Virtanen et al. 2020). Sámi reindeer herders understand ‘sustainability’ through nine basic dimensions that must be present to secure sustainable reindeer husbandry (Eira et al. 2016). Thus, the concept of food ethics as an attempt to rectify the unsustainability of western food value chains, holds little relevance for Indigenous Peoples’ food systems.

Our values (what we think is good) and principles (what we think is right) define ethical food. Food ethics covers and connects the relationship between all the complex food production value chains, including producers, lawyers, consumers, citizens, and authorities (Kaiser and Algiers 2016).

Kaiser et al. (2021) stress a need for a bottom-up, non-partisan, regional, and cross-sectoral deliberative framework for ethical food future. This requires transdisciplinary dialogues, that recognize the plurality, the uncertainties, and the diversities among food actors and knowledge cultures (Kaiser et al. 2021). Co-production of knowledge attains equity in research and brings different ways of knowing, worlds-views and experiences together by generating new knowledge (Yua et al. 2022). Such transdisciplinarity and co-production may guide us to better ethics in food, environment, and culturally diverse living conditions (Stith et al. 2022). This framework defines the co-production approach adopted in this paper to document Sámi *lávvu*-smoking.

Methods

This paper uses an ethnographic (Marcus 1995), participatory (Cornwall and Jewkes 1995) and qualitative descriptive approach (Sandelowski 2000). Based on ethical research recommendations on co-production or partnership with traditional knowledge holders (i.e. IASSA (2020), and Sundset et al. (2007)), this study secured participation of Sámi traditional knowledge holders of reindeer meat smoking both in its planning, data collection, analysis, and writing. The research is transdisciplinary and also involved experts in reindeer husbandry, biology, chemistry, ethnology, Indigenous resource management, linguistics, and educational science.

Selecting Key Cases and Smokers

Firstly, we planned the study based on preliminary data collection, i.e., dialogues, interviews, and observations at reindeer herders' gatherings, food festivals, and food courses. We performed two individual, preparatory interviews with reindeer herders and one with late Astri Riddervold, a scientist in food preservation, chemistry, and ethnology. The initial data collection was crucial to identify the scope and research needs of Sámi reindeer herders' meat smoking practices, the research design, and the key areas and smokers (in this case, traditional knowledge holders or experts in Sámi food smoking).

Our study cases are located in Troms and Finnmark, the major reindeer husbandry regions in Norway. To find the "right" key knowledge holders for in-depth interviews, Davis and Ruddle (2010), recommends identifying the most knowledgeable (traditional knowledge experts) in the local community. In our case, partnership with the International Centre for Reindeer Husbandry (ICR) was crucial in identifying and recruiting key smokers. These are elderly Sámi herders who have experienced "pre-modern" reindeer husbandry, and who play a decisive role in the preservation of traditional practices. The selected key smokers were four men above age 70, with life-long experiences of reindeer herding and smoking reindeer meat. A key difference between the smokers were their different choices of wood used for smoking (either birch or willow). In this paper, we name them 'herders' collectively and 'Willow-smoker I and II' (WS I and WS II) and 'Birch-smoker I and II' (BS I and BS II) individually. Additional *siida* members participated in the conversations during the workshops. For simplicity we refer to them as a single smoker.

Data Collection

Secondly, we collected the primary data through four ethnographical workshops: one with each of our four selected key smokers who were all from different areas in the region. The workshops included qualitative interviews, observations, and participation. They centered around the practices of smoking reindeer meat and related activities: reindeer roundups, slaughtering, meat-salting, *lávvu* pitching, firewood harvesting, and preparation or sale of the smoked meat. Thus, the data collection was flexible and adapted to the herders' work. During the workshops, we organized interviews as conversations in groups of 2–8 scientists, smokers and technicians. We asked questions using both North Sámi (*Davvisámegiella*) and Norwegian languages (see a list of the interview questions in the Appendix).

The collected data included fieldnotes of observations, photographs, and audio- and video recordings. During the interviews we studied photographs of different smoking techniques and practices retrieved from a self-made photo-book inspired by the methods used

by Eira (2012) and Sara and Mathiesen (2020). As a communication aid, we looked at artefacts and wood, and prepared and ate smoked meat.

Co-analysis

Thirdly, to start the data analysis, we reviewed field notes and photographs. Raw data was presented, discussed, and interpreted at feedback meetings in the RIEVDAN research project group at ICR. The group included Sámi herders and scientists with expertise in reindeer husbandry. These co-analysis meetings shaped the focus of the research: smoking on different wood. Comparative analysis of the workshop data revealed general steps of the Sámi *lávvu*-smoking. Based on these steps, and our main focus, we coded relevant recordings. We categorized the transcribed interviews according to a grounded theory approach moving between theory and empirical material, as described in e.g. Charmaz and Belgrave (2012). For example, did we explore general theoretical definitions of traditional knowledge, and the material displayed a clear variety in Sámi smoking knowledge. Reversely, did we survey the knowledge of *lávvu*-smoking from empirical material, pursuant to generational transfer of knowledge described in theory, e.g., Nordin-Jonsson (2010).

Research results build on information from the smokers, observations by the scientists, and findings from the co-analysis meetings. All quotes are translated from North Sámi or Norwegian. The presented Sámi knowledge and North Sámi terms (given in italics and brackets) do not represent the knowledge and terms of all Sámi reindeer herders. Rather they demonstrate examples of Sámi knowledges and practices.

Results

Sámi reindeer herders' traditional smoking practice (*suovastuhttit*)—which we call *lávvu*-smoking—follow some general steps: Before smoking, the herders collect the firewood, and—if not done beforehand—they pitch and prepare the *lávvu* at a carefully selected location, season, and weather conditions. They salt the meat overnight before hanging it in the *lávvu*. During smoking, the herders generate smoke by firing specific firewood in a particular order. After smoking, the herders cool the smoked meat before preparing or storing it for later use.

The choice of wood and the smoke generation process are essential distinctive features of the Sámi *lávvu*-smoking studied.

The Smoker

In the cases studies, both male and female herders held traditional knowledge of smoking. While the men were mainly responsible for the actual smoking practice, the women more or less assisted in the meat and *lávvu* preparations, but had the main responsibility for cooking the smoked meat. When living in the *lávvu*, the men were responsible for gathering the wood, while the women took over when the men were herding (BS II). The identified knowledge and practices were part of a collective body of food knowledge and traditions held by the family, the *siida*, or the local herding community and previous generations.

The herders learned smoking mainly from their fathers, or from other elders in the family, for example a grandmother. “I learned smoking [as a child] by watching how the others [elder family members] did it”, Willow-smoker I tells.

Birch-smoker I recalls that smoked meat used to be stored on sledges or in backpacks, easy and quick to prepare when resting by the fire. Birch-smoker II adds that smoking the meat would lighten its weight, making it easier to carry. The smoke would also prevent flies from settling on the meat on warm summer days (WS II, BS I). Today, the unique taste is another reason for smoking (WS I).

The Smoking Location (the *lávvu*)

All herders smoked reindeer meat in a *lávvu* (Figs. 1 & 2). The smoke comes from an open fire centered in the *lávvu*. The smoker controls the smoke by adding specific wood types according to their assessment of the fire and the meat (Fig. 3).

The location of the *lávvu* is important to keep air flowing downward through the top-opening (*reahpen*). Pitching the *lávvu* in advance allows the wind to ventilate and clean the *lávvu*. Another way to clean the *lávvu* is to set up a fire before hanging the meat for smoking. Cleaning is crucial after longtime storage of the *lávvu* canvas (WS I). The *lávvu* floor is made of wood branches, facilitating a draft to the fire. To clean the floor, old branches are changed, but for hygienic reasons not added to the fire when smoking (according to a female

Fig. 1 Traditional Sámi *lávvu* (tent) used for smoking reindeer meat



Fig. 2 Traditional Sámi *lávvu* (tent) used for smoking reindeer meat commercially produced

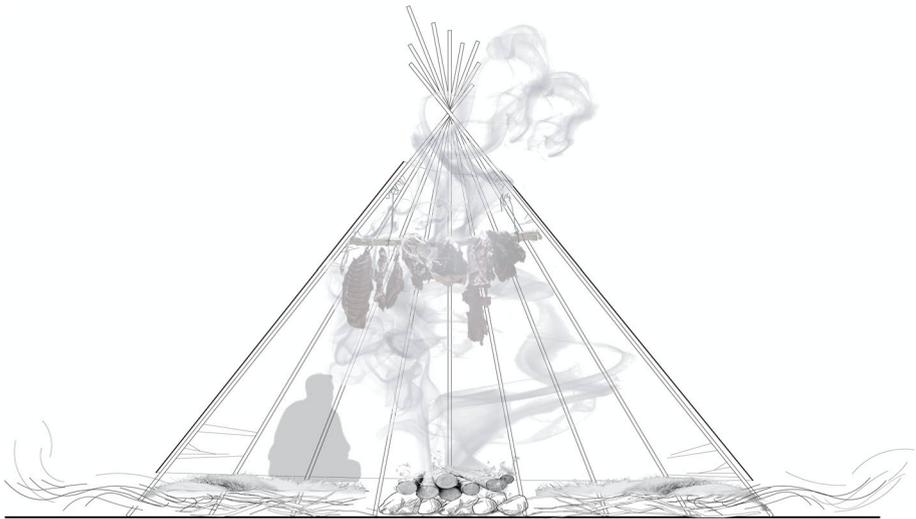


Fig. 3 In Sámi traditional *lávvu*-smoking a “smoker”—often an elder reindeer herder—sits inside the *lávvu* (Sámi tent) to control the fire and the smoke by adding particular wood species and plant parts of different wood dry-ness. Above the smoking-fire of wood meat are hung for smoking near the *lávvu* top-opening. The *lávvu* “floor” is covered with birch branches and reindeer skin, enabling airflow from underneath the canvas to the fire

herder). Also for hygienic reasons, it is not allowed to step in the kitchen or food storage (*boaššu*)—the area opposite the *lávvu* entrance (WS I; BS II). Wood used for smoking is stored inside the *lávvu* near the entrance.

The Smoking Season and Weather

The weather should not be too windy when smoking. Otherwise, the smoke would drift downward through the *lávvu* top-opening. Neither should it rain, or the meat will get wet.

High-pressure weather is best for smoking, since the smoke then will rise continuously like a long snake filling the *lávvu* before it exits through the top-opening (WS I).

The air temperature plays a role when smoking: if too warm the meat will be fried and not smoked; if too cold the meat will freeze and not become well-smoked (WS I). Currently in Northern Norway, reindeer meat is smoked in autumn (*čakča*), mainly between September and November. Birch-smoker I commented: “one smokes when one has a lot of meat [to preserve] as during the autumn-slaughtering”. In the past, smoking meat for preservation was critical in summer (*geassi*), mainly in July–August, due to high air temperatures, according to Birch-smoker II. While Willow-smoker I argues that one should not smoke when snow covers the ground, Birch-smoker II smoked meat on a cold November day with snow on the ground.

The Reindeer Meat (*bohccobiergu*)

The slaughtering season determines the sex and age of the animal chosen for smoking. Reindeer herders prefer slaughtering adult reindeer for their own consumption (Sara et al. 2022). In the past, calves would be smoked as they were slaughtered for skin clothing production in summer. For smoking, most herders choose legs (*čoarbbealli*), shoulders (*čoamohas*) and ribs (*erttet*) with the sirloins (*savodeahkki*), but sometimes also cuts of the neck (*gurti*), heart (*váibmu*), and tongue (*njuovčča*).

Before smoking, the meat cuts are salted overnight with a handful of salt each. The biggest meat cut is laid at the bottom of a container. Large bones are cut loose from the leg meat cut (*lahpat*), dividing it into one butterfly-shaped piece—convenient for hanging the meat and avoiding its souring, according to Willow-smoker I. The butchered leg, and larger shoulder cuts are stretched with a small wooden stick called *caggi* (BS II; BS I). See meat cut #5 from the left on Fig. 4. Hence the smoke reach the entire meat surface and avoid it to sour (*suvrut*), Willow-smoker II said.

The meat is hung high above the hearth (*árran*) near the *lávvu* top-opening, to ensure that the smoke is cold when reaching the meat (WS I). The meat hangs at a wooden bar—called a *suovmuorra* or *suovasmuorra* (a smoke bar)—fixed horizontally above the



Fig. 4 Reindeer meat parts hung for smoking in the *lávvu* (Sámi tent)

ground (Fig. 3 and Fig. 4). To ensure all meat parts are smoked, they should not touch each other while hanging (WS II). One can use twigs to separate the meat cuts (BS I).

Each meat cut has a specific place on the smoke bar: long ribs, and small meat cuts hang alongside the fire, where it is not too warm. Meat-ful cuts hang in the middle because “they need more smoke” (BS I). Herders adjust the heat and the smoke to the meat cuts by changing their position during smoking. This ensures homogenous smoked meat cuts (BS II; BS I; WSI).

The Wood (*muorat*)

The four participating herders used four different combinations of wood species, plant parts and wood dry-ness (Table. 1). “We use what is there”, they said when asked what kind of wood they use for meat smoking. They would only use natural local wood for smoking. The herders state that plastic, garbage, or painted wood should never be added to the fire when smoking; this will affect the taste of the smoked meat (Birch-smoker II and Willow-smoker I). “Plastic is the worst” (BS II).

Wood Species

For smoking, herders mostly used willow (*siedga*) or birch (*soahki*) (Table 1). Birch-smoker I, Birch-smoker II, and Willow-smoker II are from West-Finmark, Willow-smoker I is from East-Finmark. Birch-smoker II only chooses willow when no birch is available, e.g., at high altitude. Willow-smoker I only chooses birch wood when boiling coffee, for instance. Then he make the birch fire outside the smoking *lávvu*.

If available (and not covered by snow, Birch-smoker II and Willow-smoker II say), all herders might add juniper (*reatkkát/gaskasat*) for a stronger, smokier taste of the meat. None of the herders would use pine wood (*beahci*) for smoking—it produces a tar-like taste, Birch-smoker I explained.

Wood Dryness

Willow-smoker I and Birch-smoker I only use fresh wood (*njuoska muorat*) for smoking. Willow-smoker II and Birch-smoker II mostly use fresh wood, but also add some dry wood (*goike muorat*) when smoking with willow and birch, respectively. Herders chop fresh wood right before smoking. The dry wood is between a few months and a year old.

Wood Plant Parts

While Birch-smoker I and Birch-smoker II use lots of *rissit* (twigs) for smoking, Willow-smoker II and especially Willow-smoker I use *čoskka* (larger wood logs). Willow-smoker I says that the logs; “should be thick, because they are moist ... do not burn fast...and create lots of smoke”. The larger logs burned calmer without high flames (BS I). “Adding twigs gives a darker smoke” (BS II). Birch-smoker II also experienced that “dry wood creates less smoke...fresh wood creates a lot” and “when I add dry wood it makes more white smoke (*vilgers suovva*)...when I add twigs, the smoke becomes more black” (BS II).

The herders have different opinions about using wood with leaves (*lasttat*): While Birch-smoker I uses birch twigs with leaves for smoking in September, Birch-smoker II removes the leaves when smoking in early autumn. This to avoid leaves from flying up and sticking

Table 1 Four combinations of wood species, wood plant parts and wood dry-ness used for traditional Sámi *lávvu*-smoking of reindeer meat

<i>Muorat</i> – the wood	
Willow	 <div style="float: right; padding-left: 10px;"> <p>Smoker I (Aug)</p> <ul style="list-style-type: none"> - fresh logs - dry twigs - leaves <p>Juniper</p> <ul style="list-style-type: none"> - small amount </div>
	 <div style="float: right; padding-left: 10px;"> <p>Smoker II (Oct)</p> <ul style="list-style-type: none"> - fresh logs - few fresh twigs - without leaves <p>Juniper</p> <ul style="list-style-type: none"> - small amount </div>
Birch	 <div style="float: right; padding-left: 10px;"> <p>Smoker I (Sep)</p> <ul style="list-style-type: none"> - fresh logs - fresh twigs - leaves <p>Juniper</p> <ul style="list-style-type: none"> - 50% </div>
	 <div style="float: right; padding-left: 10px;"> <p>Smoker II (Nov)</p> <ul style="list-style-type: none"> - fresh logs - dry and fresh twigs - without leaves <p>Juniper</p> <ul style="list-style-type: none"> - None </div>

on the meat. “It should be clean, it is food”, Birch-smoker II explain. Willow-smoker I also prefers willow without leaves, and mostly uses logs. Willow-smoker I adds that “[i]t is best to smoke when the wood is green and has more moisture”. When the trees have shed leaves in late autumn, one must observe the fire more carefully, Willow-smoker I argues. The smoke from wood with leaves is darker (BS II), thicker, and gives a stronger taste (WS I). In November, December, and January, the wood is drier and burns faster (BS I). “When there are no leaves, the smoke becomes evener” (BS II).

The Fire and Smoke Generating Process (*dolla* and *suovastuhttin*)

The process of making a smoking fire (*suovastuhttin dolla*) differs among the participating herders due to seasonal factors and different wood species. All four types of fire (*dolla*) and smoke (*suovva*) appear in Table 2 and Table 3. The wood should always be added to the fire in the same direction—diagonal from the entrance to the kitchen. The fatter end should point toward the kitchen and be long enough to rest on the stones surrounding the fire. (BS II).

Starting the Fire

The first fire made in the *lávvu* is *boahtán-dolla*, the “just-arrived-fire” (Birch-smoker II). This fire is used to clean the firepit, and (if needed) to melt the snow and generate the heat needed to keep the fire going.

To start the fire, the herders use small quantities of dry birch (*goike soahki*) and bark (BS I; WS I), dry willow wood and bark (WS II), and fatwood, bark, and dry twigs (BS II). Thereafter, they add fresh wood of either birch or willow. The amount of wood added is not specified. It is as if the herders know from experience what the “appropriate” amount is.

Using fresh, wet, and raw birch (*njuoska soahki*) is important early in the smoking process. This wood produces a good clean smoke, important since the first smoke penetrates deeper into the meat (BS II). Birch-smoker II notes: “It is important that one wait to add wood with leaves to the fire until the meat has become dry, otherwise the leaves which “fly up” will “stick to the meat”. Birch (WS I), and especially dry birch twigs with leaves (BS II), generate more flying leaves that stick to the meat. Also to avoid this, Birch-smoker II tells that children are taught not to mess in the fire by telling them that “their reindeer calf would lose an eye” (*miessi šadda čalbmētbeallin*).

During the Smoking Process

After the meat has acquired a harder and more protective outer layer (after 1–2 fires), one can add dry birch (BS II). Willow-smoker II argues that adding some dry wood during the smoking process would keep the fire going. Smaller willow twigs (*sieđgaskierri*), often twisted before going into the fire, are used early in the smoking process (Willow-smoker I). Later in the process, Willow-smoker I prefers to feed the now warmer fire with larger moister willow logs. A moist smoke is called *njuoska suovva*, a dry smoke is called *goike suovva*.

If the smoking temperature gets too high, the meat will be fried, instead of smoked, Willow-smoker I emphasizes. Moist large wood logs (*čoskka*) are used to avoid and reduce a flaming fire (BS II; WS I). The herders also add water (WS I; BS I) or snow (BS II) to reduce high flames. But, as Willow-smoker II notes, adding water to the fire may generate soot on the surface of the meat.

Table 2 Fires related to the four different wood combinations (as appear in Table 1) used for traditional Sámi *lávvu*-smoking of reindeer meat

Dolla - the smoking fire	
Willow	 <div style="float: right; padding-left: 10px;"> <p>Smoker I (Aug)</p> <ul style="list-style-type: none"> - Low flames, dark fire - Constant monitoring - Subsequent fires - Only small breaks (before flies will come) </div>
	 <div style="float: right; padding-left: 10px;"> <p>Smoker II (Oct)</p> <ul style="list-style-type: none"> - Low flames, dark and cold fire - Present to feed the fire - Leave the fire for hours - 1½ - 2 fires </div>
Birch	  <div style="float: right; padding-left: 10px;"> <p>Smoker I (Sep)</p> <ul style="list-style-type: none"> - Higher flames, bright and warm fire - Constant monitoring - Subsequent fires </div>
	  <div style="float: right; padding-left: 10px;"> <p>Smoker II (Nov)</p> <ul style="list-style-type: none"> - Higher flames - Fire-monitoring every half an hour - Only leave the fire after adding logs - 3-4 fires </div>

Table 3 Smoke from four different fires (as appear in Table 2) of four different wood combinations (as appear in Table 1) used for traditional Sámi *lávvu*-smoking of reindeer meat

<i>Suovva</i> - the smoke		
Willow		Smoker I (Aug) - Moistures bright smoke
		Smoker II (Oct) - Moistures bright smoke
Birch		Smoker I (Sep) - Variable dense and darker smoke
		Smoker II (Nov) - Evener drier smoke

A sign of a too-hot-fire is that fat starts to drip from the meat and that the fire flames (WS II; BS I). The fire may make a crackling sound (*šnjirrát*) when fat drips or water is added to it. Willow-smoker I claims that more fat drips from the meat above a birch fire because birch creates higher flames. Birch-smoker I avoids dripping fat and high flames by moving the fatter meat away from the fire to the side. Willow-smoker I does

not prefer smoking fat reindeer meat, because the smoke hardly penetrates the subcutaneous fat and thus the meat below.

Birch-smoker I stays inside the *lávvu* the whole time during smoking to continually monitor the fire and the meat and to add suitable firewood (or water) if the fire flames as it often does with birch. Birch-smoker II said that he would always check the smoking-fire at least every half an hour. “When leaving the fire, I am careful to only add larger logs, and not small twigs that create high flames” (BS II).

Willow-smoker I would leave the fire for longer periods (more than 2 h) because fresh willow burns with fewer flames. Such fires are calm and often with red glowing embers (*aššu*). It is important to have “breaks” in the fire process “to let the meat cool”, according to Willow-smoker II. The length of the breaks depends on the season. To let the meat cool between the fires is important in *čakčageassi*, August–September (BS II). In August, one should not wait too long before adding firewood to the fire—otherwise flies would come, Willow-smoker II explained. In November, one does not need to monitor the fire continuously (BS II). I.A. Smuk told that, even though her father would leave the fire during smoking [with willow], he always had control: “The *lávvu* was located near the corral [where they gathered the reindeer to earmark the calves] so he could see whether smoke rose from the smoking *lávvu*”.

If the smoke is too hot for long periods during smoking, the meat could get a bad smell (*guohca hádja*) or even *muováskit*, Willow-smoker II, Birch-smoker I, and Birch-smoker II argue. *Muováskit* is a concept the herders use to explain that meat could go foul and maybe even green near the bone because of the heat, becoming inedible (BS II, BS I, WS II). To avoid this, the meat hanged for smoking should be moved alongside the fire away from hot flames, when cooking food or boiling coffee, Birch-smoker II and Willow-smoker I said.

Juniper is a spice, that should be added late in the smoking process, Willow-smoker I argues. “Juniper has a sharp taste, so one should not use a lot” (WS I). Birch-smoker I, on the other hand, uses 50/50 birch/juniper. Juniper generates lots of smoke and high flames (*dolla njivžu*), a warm fire, and a crackling sound (*ruohččá*) followed by sparks and ashes (*čuonan* and *gavja*) which fly up and stick to the meat as “white spots” (BS II; WS II).

Smoking Time – Number of Fires

The smoking time is often described by ‘number of fires’: Willow-smoker I smokes ‘one and a half’ or ‘two fires’. Birch-smoker II smokes ‘three’, maybe ‘four fires’. Willow-smoker II and Birch-smoker I, who continuously monitored the fire, add firewood constantly. The smoking time depends on the firewood used, the herder’s preferences, the outside temperature, the age and sex of the reindeer, the size of the meat cuts, the intervals between the fires (WS II), and the size of the *lávvu* and its top-opening (WS I): Smoking in colder weather, for example, takes longer time. Willow-smoker I notes: one can smoke in air temperatures below zero as long as the smoke prevents the meat from freezing.

If the *reahpen* is too wide, the meat needs longer smoking time because the smoke “disappears” too fast (BS I). Willow-smoker I narrows the *reahpen* to delay the escape of the smoke. However, new, fresh smoke should continuously rise and pass the meat through the *reahpen* (WS II). If it is too smoky inside the *lávvu*, the draft is regulated by lifting the canvas near the ground (*soggi*) or adjusting the *reahpen* at the canvas top (BS I; BS II). “The *lávvu* door is usually closed during smoking” (BS I and WS I).

After Smoking

The herders sensed the smoked meat (called *suovasbiergu*) to evaluate whether it was well-smoked. Well-smoked meat feels dry, not sticky (BS I and WS I) and “stiffer than when we started” (WS II).

The color of the smoked meat changes depending on the wood used: Willow-smoked meat becomes light red (WS I, WS II); birch/juniper-smoked meat turns brown with a dark red nuance (BS I), and meat smoked solely on birch turns dark brown (BS II) (Table 4).

The taste of the smoked meat also differs depending on the wood and the herders’ preferences: While willow-smoked meat tastes mild (WS I), birch-smoked meat is more bitter, stronger, or even has a stinging taste (*gárkkis*) according to Willow-smoker II. Birch-smoker II and his wife, who prefer birch-smoked meat, describe meat smoked in a

Table 4 Reindeer meat smoked with smoke (as appear in Table 3) from four different fires (as appear in Table 2) of four different wood (as appear in Table 1) used for traditional Sámi *lávvu*-smoking of reindeer meat

<i>Suovasbiergu</i> – the smoked meat		
Willow		Smoker I (Aug) - Light red - Mild taste
		Smoker II (Oct) - Light red - Mild taste
Birch		Smoker I (Sep) - Dark red - Ash (white spots) on the outside - Strong taste
		Smoker II (Nov) - Dark brown - Strong taste

smokehouse with wood chips as *gárkkis*. Herders that prefer willow-smoked meat (WSII), describe the birch-smoked meat taste as more smoky and bitter (*rihča*).

When done, the meat is left hanging in the *lávvu* to cool, dry further and stretch (BS I and WS I). After smoking “you should never put the smoked meat directly in the freezer or it will *muováskit*... I leave the meat hanging over night for it to cool” (BS I). In the past, when smoking for preservation, it would take more time, resulting in a very strong smoky taste of the meat. Strongly smoked meat was boiled before frying, Birch-smoker II's wife noted. Herders, smoking with birch, still boil the smoked meat to remove some of the strong smoke taste. Boiling also makes the smoked meat tenderer.

Discussion

Is Sámi *lávvu*-Smoking Holistic and Complex?

Our findings support that the Sámi reindeer herders hold a holistic understanding of how to deal with complex relations of reindeer meat smoking, supporting the multifaceted paradigm of traditional knowledge.

Sámi herders have settled in houses in recent generations, yet they still prefer to smoke meat in the *lávvu*. It is however not the *lávvu* itself that makes the smoking traditional, nor that it is performed by the Sámi people or by the use of local firewood. Rather, one needs a holistic understanding of the interactions between and the variations of multiple inter-related elements embodied by the Sámi herders (cf. Nakashima and Roue (2002)). It involves the knowledge of e.g., appropriate season and weather for smoking, what age and sex of reindeer to smoke, when and how to butcher it, how different types of wood and fire-feeding strategy affect the appearance of the smoke and its behavior, and the change of meat color and structure after smoking.

Our study also shows that the different elements of *lávvu*-smoking are connected to a complex web of values. They include herders' purpose for smoking: preservation, lessening the meat weight for transportation, easy preparation, or reaching a preferred taste. The values have altered with time. In the past, herders would not have freezers, which made smoking for preservation purposes of great value. Sanitary regulations of reindeer slaughtering (Reinert 2006) may also have affected current practices of *lávvu*-smoking. Nevertheless, the purposes and values underlying the smoking practice define different typologies of smoking: using various wood species (birch or willow and juniper), different levels of dryness (moisture or dry wood) and different wood plant parts (logs, and twigs with or without leaves). The different smoke generation typologies also illustrate the complexity of Sámi *lávvu*-smoking.

Peloquin and Berkes (2009) and Berkes (1999) discuss how other Arctic Indigenous Peoples deal with complexity. Correspondingly, the Sámi herders in this case study, do not use quantitative measures (such as temperature or humidity measurements). They rather make use of a qualitative mental model (cf. Berkes (1999: 144)) that provides them with an indication (fuzzy logic, cf. Berkes and Berkes (2009)) of a what is a *clean smoke*—a desired and good smoke. This qualitative model reveals instructions for what to do (e.g., add large moist logs) to ensure a good *clean smoke*. In contrast to scientists, the Sámi herders do not require the quantitative temperature estimation to decide on cooling the smoking-fire. Instead, the herders' knowledge of a too-hot-fire can be seen as rules-of-thumbs, cf. Berkes (1999). Examples of the herders' rules-of-thumbs discussed in this paper are for

instance to *only use fresh, wet, raw wood early in the smoking process and if the fatter meat cuts are dripping, the fire is too hot—move the fat meat cuts aside.*

The complexity of Sámi traditional *lávvu*-smoking also include tightly controlled factors, conscious choices, and hygienic rules. The studied Sámi *lávvu*-smoking practices, for example, embedded hygiene-rules to secure a clean location for smoking. E.g., by changing the *lávvu* floor branches, by starting a fire inside the *lávvu* before hanging the meat, and by not stepping in the kitchen area.

Is Sámi *lávvu*-Smoking Local?

Since traditional knowledge incorporates both old and new experiences, cf. Berkes (1999), we see the variations in smoking practices as an expression of the diversity of local ecological knowledge. Experiences are based on adaptation to local conditional changes. Eira et al. (2016) argue that there are individual and household knowledges, local *siida* knowledges, and a more general Sámi knowledge exchange between *siidas*—Sámi herding communities. All these forms of knowledges may be reflected in the different, but still similar, practices of smoking.

The environmental conditions in the Sámi reindeer husbandry area differ between coast and inland, North and South. Various local conditions could therefore partly explain the different choice of wood utilized for smoking reindeer meat.

Generally, in Northern Norway, mountain birch (*Betula pubescens* ssp.) dominates below the forest boundary (Elven and Fremstad 2018: 544), and the total range of willow amounts only to 3.2% of total deciduous volume (Kucera and Næss 1999; Myking et al. 2013). An exception is the valleys in the North East of Finnmark, where the birch forest gradually disappear, replaced by downy willow (*Salix lapponum*) or other elsewhere shrub-like willow species which in this area grow as high as 3–4 m (Elven and Fremstad 2018: 540–41). The herder in the North East of Finnmark uses willow to smoke meat. Birch dominates near their winter pastures further south, but the same herders still prefer to use willow, because of the smoke and mild taste it adds. Birch dominates in the rest of Finnmark, where two of the herders use birch for smoking. However, the fourth herder, smokes with willow, even though birch dominates in his herding grounds. Indeed, this willow-smoker and the two birch-smokers live and herd their reindeer within relatively limited geographical distances as they use neighboring winter herding areas.

Our results show that the use of different wood species, wood plant parts, and wood dryness are strongly related to local smoke generating processes: the actions to regulate and monitor the fire. Birch-smoking herders must continuously monitor the fire. Willow-smoking herders can leave the fires for hours—by experience he knows that the fire would not produce high flames. Traditional knowledge regulates the when and how to use dry wood or twigs with or without leaves. We argue that this link between the wood and the smoking practice displays a systematic way of knowing, cf. Arctic Council (2015).

Furthermore, traditional knowledge of smoking meat and fish for conservation has been practiced all over the world (Riddervold and Ropeid 1988). The custom of food smoking by Arctic Indigenous Peoples in Alaska, Canada, Greenland, and all over Eurasia have been documented in literature from 1850 to 1950s as reviewed by Eidlitz (1969: 106–07). For example (as cited in Eidlitz (1969)), *Västerbottens-lapparna* [Sámi people in Northern Sweden] dried and smoked meat over the fireplace in their *kåta*—hut (Drake 1918: 135); the Inuit dried whale meat in smokehouses (Stefánsson 1914: 137 f); and the Inuit and

neighboring First Nations and reindeer Chukchi in Siberia smoked reindeer meat above the fire in their tents (Turner 1894: 277; Lindow 1924: 21; Bogoras 1904: 196).

Today a particular flavor may have become the primary aim of smoking foods, to achieve a certain quality and a varied diet (Putten 1988). For example, smoking with sheep dung offers a distinct flavor to the meat. Therefore, this Icelandic method evolved by farmers is used to produce smoked sheep meat (*hangikjöt*) even in industry-smoking today (Steingrimsdóttir et al. 2018; Håseth et al. 2014). This is an example of applying traditional knowledge to find local alternative solutions. It also displays the possibility of incorporating traditional practices in modern food industry.

Different smoking techniques among Arctic Nomadic peoples indicate a much larger variety of traditional smoking knowledge than described here. We suggest further investigation to compare traditional smoking among Arctic Indigenous Peoples.

Is Sámi *lávvu*-Smoking Transmitted Through Generations?

Our findings show that reindeer meat smoking is mostly conducted and passed on by the father or other elder Sámi men. Men are the main practitioners and transmitters of connected knowledge and practices. The rationale might be the following: The elder herders informed us that when living in *lávvu* the man would sit closest to the firewood—the woman closest to the kitchen area (*boaššu*). This has also been described in historical sources (Hansen and Olsen (2014). The man would also mainly be responsible for picking the firewood for smoking—the woman mainly for the preparation of the smoked meat, but both are important to the Sámi household (*báikevuodđu*), seen traditionally as a learning base (Eira et al. 2016). Modern slaughterhouses affected the reindeer herders learning base and knowledge transmission as investigated in a recent study by Sara et al. (2022). Sámi knowledge in a modern setting may currently be transmitted based on the educators' experiences, documentation of knowledge, and traditional knowledge from their upbringing or through collaboration with knowledgeable reindeer herders.

Reindeer herders' knowledge is accumulated and communicated through specialized Sámi language generating a basis for their thoughts and practices (Eira et al. 2016). The herders know from experience when the fire is too hot, when the smoke is clean, and when the meat is well-smoked. We argue that the herders' knowledge of assessing *lávvu*-smoking are not only *diehtu* (theoretical knowledge about the practice), but they hold embodied skills, *máhttu* cf. Guttorm (2011), based on their knowledge base—*máhtovuodđu* cf. (Eira et al. 2016). A person with good practical skills in something may in Sámi also be described as *čehppodat* (Guttorm 2011)—*suovastuhttin čehppodat* in the case of *lávvu*-smoking.

Together all the Sámi 'fire rules' are examples of how the herders' knowledge of *lávvu*-smoking is verbally transmitted from generation to generation, cf. Berkes' et al. (2000), FAOs (2021), and Nordin-Jonsson's (2010) definition of traditional knowledge. "[I]n the Arctic, each generation passes down the knowledge of how to live in a harsh environment, and over time this knowledge is tested and refined" (i.e., Sidik 2022). Many Indigenous participants recognize similarities between processing in their own lives and the scientific peer review process, which can be described as "a method for validating knowledge before it's published" (Sidik 2022).

Based on our findings, we argue that also Sámi traditional experts' experiences and 'rules' of *lávvu*-smoking from childhood and previous generations have been undergoing

a continuous and ongoing internal quality control process comparable to a scientific peer-reviewed process.

How can Sámi *lávvu*-Smoking Contribute to Food Ethics and Sustainability?

The need to establish healthy and sustainable food systems is part of a global discussion of ‘less but better’ regarding human meat consumption (Sahlin et al. 2020; Willett et al. 2019; Gordon et al. 2017). Based on the continuity of *lávvu*-smoking, we argue that reindeer meat production and processing is integral to social sustainability (cf. WCED (1987)). Social sustainability may according to Sámi perspectives of sustainability include the herder, their knowledge, their ethics, their household, their family, their *siida* and their herd and herding grounds (Eira et al. 2016). To support ethical and sustainable Sámi food production, we suggest that national and international recommendation bodies acknowledge the holistic nature of the traditional knowledge. Indigenous Peoples’ food system knowledges are essential for establishing sustainable food systems (FAO 2021; Lugo-Morin 2020). In the Arctic, we suggest that increased use of traditional and local foods (such as smoked reindeer meat), based on local resources (such as local firewood), could lead to more sustainable and ethical food systems. Krarup Hansen et al. (2022) concluded that bridging traditional and scientific knowledge in research is essential for knowledge co-production, increased understanding of Indigenous peoples’ traditional food practices and ethics.

Conclusion

This paper documented the traditional knowledge of *suovastuhttin* (*lávvu*-smoking) held by the Sámi reindeer herders in Northern Norway. Methods of co-production was important for the selection of key cases and participants, and for the data collection and analysis. We uncovered a typology of smoking practices with explicit knowledge of when to smoke, what type of reindeer and what meat cuts to smoke, how to butcher and salt the meat, and how to hang it on the *suovasmuorra* (smoke-bar) inside the *lávvu* (tent). The herders smoke reindeer meat during late summer and autumn migration and slaughtering for preservation, meat weight reduction, and to make meat easy available for direct consumption. *Suovasbiergu* (smoked reindeer meat) comprises an important part of the herders’ seasonal diet both in the past and today.

Herders use only natural and mostly fresh wood of either birch or willow in combination with juniper. The use of different firewood species, plant parts, and dryness vary among the Sámi reindeer herders within a relatively short geographical distance. Correspondingly, the fire and smoke-generating process and the smoked meat palatability and color vary depending on the wood used. Traditional knowledge defines herders’ choice of wood and practice.

The adherence to general definitions of traditional knowledge discussed in the paper allows us to develop strong evidence that reindeer herders hold rich, holistic, and complex meat smoking traditional knowledge. It is important in herders’ assessment and control of the smoke and the smoked meat quality. The unique Sámi traditional food control systems of *lávvu*-smoking are generated by practical experience and generationally transmitted and expressed through *mental models* and several *fire rules*. The knowledge of Sámi *lávvu*-smoking is dynamic and adaptable to environmental changes, such as seasons, weather, and the use of different type of reindeer and meat cuts.

By incorporating traditional knowledge and local resources, such as reindeer meat and local firewood, we argue that these traditional smoking practices support Indigenous Peoples' food sustainability and ethics. However, modern demands, globalization, and national assimilation challenge traditional practices and indigenous cultural sustainability and survival. Sámi reindeer herders' food knowledge systems are under pressure and require protection. To ensure transmission of Sámi *lávvu*-smoking knowledge to future generations, we urge the inclusion of traditional knowledge in Sámi education and industrial production methods.

Appendix: List of Interview Questions

In North Sámi:

- 1) Geas ja goas leat oahppan suovastuhttit?
- 2) Gos suovastuhttet biergguid (lávus, goađis, suovastuhttinvisttis, suovastuhttinommanis)?
- 3) Goas jagis suovastuhttet biergguid? Goas ii suovastuhtte biergguid?
 - a) Go lea šaddimánnu?
 - b) Go lea muohta eatnama alde?
 - c) Boazobargguid oktavuodas?
- 4) Gii suovastuhtte biergguid? (Nissonolmmoš/dievdoolmmoš, nuorra/vuorrasit olmmoš, mearrasápmelaš, boazosápmelaš, olbmot geain ii leat gullelašvuohta boazoealáhussii/dálon?)
- 5) Suovastuhtte go biergguid fárrolaga earáiguin vai dušše okta olmmoš?
- 6) Makkár bohcco gorudiid suovastuhtte? (Ahki, njijnelas/varis)
- 7) Suovastuhttet go buoiddes vai guoira biergguid?
- 8) Movt gottát, njuovat ja rihttet bohcco maid áiggut suovastuhttit?
- 9) Makkár ruvjiid suovastuhttet (gurppi, márfi, eará)?
- 10) Sáhtta go olles goruda suovastuhttit?
- 11) Makkár ovdabargu lea go galga suovastuhttit?
- 12) Saltet go biergguid? Geavahat go roavva vuoi finna sáliti? Sohkkara? Doiddát go biergguid?
- 13) Movt henget biergguid?
- 14) Mii lea lávus go suovastuhttet biergguid?
- 15) Makkár muoraid boalddát go suovastuhttet?
 - a) Galget go muorain lastat?
 - b) Naba bárku?
 - c) Man gassa muorat?
 - d) Goas leat muorat čullojuvvon?
 - e) Gos leat murren?
 - f) Man ollu muoraid boalddát go suovastuhttet biergguid?
- 16) Movt álggát suovastuhttima ja movt suovastuhttet biergguid?
- 17) Makkár lea buorre suovva? Makkár lea heitot suovva?
- 18) Man guhka suovastuhttet biergguid - galle dola??
- 19) Leatgo ieš lávus go suovastuhttet biergguid?
- 20) Maid lea dehálaš jurddašit ja muitit go suovastuhtte bierggu? (temperatuvra, láktasa, áibmu, ráinnasvuohta)

- 21) Leago mihkkege maid ii galgga dahkat dahje galga dahkat go suovastuhtte?
- 22) Leatgo iešguđetlágan mállat ja vierut go suovastuhtte? (Guvlui čadnon dahje bearrašii)
- 23) Movt árvvoštalat goas biergu lea nohkka suovastuvvon?
- 24) Makkár lea garvves suovastuvvon biergu? (Máhku, ivdni, konsisteansa, hádja, riiban ja eará)
- 25) Movt galga suovasbierrgu vurkkodit mañnel suovastuhttima?
- 26) Goas borat suovasbierrgu?
- 27) Movt ráhkadat suovasbierrgu?
- 28) Leat go sánit dahje doahpagat mat čatnasit bierrguid suovastuhttimii?
- 29) Manne suovastuhttet bierrguid? Lea go suovasbierrgus earenoamáš árvu? Ekonomalaš, kultuvrralaš, álbmáivuohhta vai sosiála árvu/árbevrierru?
- 30) Geat ostet dus suovasbierrgu?
- 31) Leatgo hástalusat čadnon du suovastuhttin vuohká? Biebmobearráigeahčču, lágat, reguleremat jnv.
- 32) Leatgo rievddadan vuogi movt suovastuhttet bierrguid? Jus leat, movt ja manne?
 - a) jagi áigi, geassi/dálvi
 - b) gos suovastuhttet (lávvu)
 - c) bierrgu gieđahallan ovdal, go suovastuhtte ja mañnel
 - d) makkár muoraid anát, sálta jnv.
- 33) Mii lea du vuosttaš mitu bierrguid suovastuhttima birra? Muittát go go ledjet unni ja suovastuhttet bierrguid váhnemiid fárus, muittát go movt dii dagaidet? Goas jagis suovastuhttiidet? Oruidet go lávus? Suovastuhttet go eará ládje otne?
- 34) Movt oahpahuvvo suovastuhtten? Buolvvas bulvii? Geaid gaskkas? Movt?
- 35) Leat go suovastuhtten goikebierrguid? Dahje goikadan suovasbierrgu?
- 36) Leat go dus jurdagat, plánat, sávaldagat du suovastuhttenmálla birra?
- 37) Dovddat go Biebmobearráigeahču lágaid suovastuhttima birra? Movt galggašii leat?
- 38) Maid háliidat ahte mun galggašin dutkat eambbo?

In Norwegian:

- 1) Når og hvor (av hvem) lærte du å røyke?
- 2) Hvor røyker du kjøtt (lavvo, gamme, røykebu, røykeovn)?
- 3) Når på året røyker du kjøtt? Når røyker du ikke kjøtt?
 - a) Når det er ny måne?
 - b) Når der er snø på bakken?
 - c) ifht. resten av arbeidet i reindriften?
- 4) Hvem røyker reinkjøtt? (Kvinner/menn, unge/eldre, sjøsamer, reindriftssamer, folk utenfor reindriften/fastboende?)
- 5) Gjøres det i felleskap eller av en person?
- 6) Hvilken type rein røyker du? (Kjønn, alder)
- 7) Røyker du, fett eller lite fett rein?
- 8) Hvordan avliver, slakter og partere du reinen som skal røykes?
- 9) Hvilke kjøttdele røyker du (*gurpi*, pølse, annet)?
- 10) Kan man røyke en hel rein?
- 11) Hva gjør du før du røyker?
- 12) Salter du kjøtt? Bruker du grovt eller fint salt? Sukker? Skyller du kjøttet?

- 13) Hvordan henger kjøttet?
- 14) Hva er i lavvoen når du røyker? Hvordan er lavvoen innrettet?
- 15) Hvilken ved bruker du
 - a Har veden blader?
 - b Har veden bark?
 - c Hvor tykk er veden?
 - d Når henter du veden?
 - e Hvor henter du veden?
 - f Hvor mye ved brukes, brenner du, når du røyker kjøtt?
- 16) Hvordan starter du røykingen og hvordan røyker du kjøttet?
- 17) Hva er en god røyk? Hva er en dårlig røyk?
- 18) Hvor lenge røyker du?
- 19) Er du selv i lavvoen når du røyker kjøtt?
- 20) Hva er viktig å tenke på når du røyker? (temperatur, fuktighet, lufttilførsel, hygiene)
- 21) Er der noe man ikke skal gjøre/skal gjøre når man røyker kjøtt? (regler/myter)
- 22) Har du noen tradisjoner/ritualer forbundet med røykepraksisen? (Område- eller familierelatert)
- 23) Hvordan vurdere du at kjøttet er nok/bra røykt?
- 24) Hvordan beskriver ferdig røykt kjøtt? (smak, farge, konsistens, lukt, holdbarhet o.a.)
- 25) Hvordan skal kjøtt oppbevares etter røyking?
- 26) Når spiser du røykakjøtt?
- 27) Hvordan tilbereder du røykakjøtt?
- 28) Har du noen spesielle ord/begreper som knyttes til røyking av kjøtt?
- 29) Hvorfor røyker du kjøtt? Har røyka kjøtt noen bestemt verdi for deg? Økonomisk, kulturell, ernæringsmessig eller sosial verdi/tradisjon?
- 30) Hvem kjøper dine røykeprodukter?
- 31) Har du noen utfordringer knyttet til din røykepraksis? Mattilsynet, lover, reguleringer etc.
- 32) Har du gjort endring i praksisen din? Hvilke, hvordan, hvorfor?
 - a tid på året, sommer/ vinterplass
 - b hvor du røyker (lavvoen)
 - c behandling av produktet før/unner/etter røykingen
 - d bruk av ved, salt, mm.
- 33) Hva er dit første minne om røyking av kjøtt? Husker du når du var liten med dine foreldre på (sommerplassen?), hvordan røykte dere da? Når på året røykte dere? Bodde dere i lavvu? Røyker du anderledes enn da i dag?
- 34) Hvordan læres røyking videre? Fra generasjon til generasjon? Mellom hvem? Hvordan?
- 35) Har du røyket tørkakjøtt? Eller tørka røykakjøtt?
- 36) Har du noen tanker/fremtidsplaner/ ønsker ifht. røykepraksisen din?
- 37) Har du satt deg inn i Mattilsynets lovgiving? Hvordan burde den ha vært?
- 38) Hva ønsker du jeg skal undersøke/forske på?

In English:

- 1) When and where (by whom) did you learn to smoke reindeer meat?

- 2) Where do you smoke meat (in a *lávvu*, turf hut, smokehouse, smoke oven or other construction)?
- 3) Who smokes reindeer meat? (Women or men, youth or elder, Mountain Sámi (reindeer herders), Sea Sámi (original fishermen on the coast), or people outside reindeer herding. Is the practice of smoking a joint practice or performed by one person alone?)
- 4) When/what time of the year do/don't you smoke reindeer meat?
 - a When it is growing moon?
 - b When there is snow on the ground?
 - c In relation to general reindeer herding work?
- 5) What type of reindeer do you smoke? (gender, age)
- 6) Do you smoke a fat or a skinnier reindeer?
- 7) How do you exterminate, slaughter and butcher the reindeer to be smoked?
- 8) What pieces of meat do you smoke (*gurpi*, sausage, other)?
- 9) Can you smoke a whole reindeer?
- 10) What do you do before you smoke?
- 11) Do you salt the meat to be smoked? Do you use coarse or fine salt? Sugar? Do you rinse the salted meat?
- 12) How does the meat hang to be smoked? What is the distance to the fire?
- 13) How is the fixture of the smoking construction?
- 14) Which type of wood do you use
 - a Does the wood have leaves?
 - b Does the wood have bark on?
 - c How thick is the wood?
 - d When do you harvest the firewood?
 - e Where do you harvest the firewood?
 - f How much firewood do you use?
- 15) How do you start smoking and how do you smoke the meat?
- 16) What is a good smoke? What is a bad smoke?
- 17) For how long do you smoke the meat?
- 18) Are you inside the smoking construction when you smoking the meat?
- 19) What is important to consider when smoking? (temperature, humidity, air supply, hygiene) How do you control these parameters? E.g. do you throw water on the fire?
- 20) Is there anything one should not do / do when smoking meat? E.g. rules or myths to follow?
- 21) Do you have any traditions / rituals with smoking practice?
- 22) How do you assess a well done / smoked reindeer meat product?
- 23) How to describe the final smoked meat product? (taste, color, texture, smell, durability, etc.)
- 24) How should the smoked meat be stored after smoking?
- 25) When do you eat smoked meat?
- 26) How do you cook smoked meat? E.g. with or without the fat on?
- 27) Do you have any special words / concepts related to meat smoking?
- 28) Why do you smoke reindeer meat? Do smoked reindeer meat have any special value for you? Economic, cultural, nutritional or social value?
- 29) Who buy your smoked meat products?
- 30) Have you had any challenges related to your smoking practice? E.g. in relation to the Food Safety Authority, legislation, regulations etc.

- 31) Are you familiar with the Food Safety Legislation? Should it be different, and how?
- 32) What is your first memory of smoking reindeer meat? How did your parents smoke reindeer meat when you were a child? (what time of the year? Did you live in the *lávvu*?) Do you smoke differently today, how?
- 33) Have you changed your smoking practice, how, why? E.g. in relation to:
 - a time of the year
 - b where you smoke (the smoking construction)
 - c treatment of the product before, during and/or after smoking
 - d use of wood, salt, etc.
- 34) Have you smoked dry meat or dried smoked meat?
- 35) How is knowledge of smoking transfer? Between whom? e.g. between generations?
- 36) Do you have any future plans for your smoking practice?
- 37) What should a as a researcher investigate about smoked reindeer meat?

Acknowledgements Thanks to the participating reindeer herders, their families and *siidas* for sharing their knowledge. This study was initiated by Sámi reindeer herding and Sámi research communities, through cooperation with International Centre of Reindeer Husbandry (ICR) and Sámi Allaskuvla—the Sámi University of Applied Science (SAMAS). Thanks to the employees at ICR and SAMAS that shared their knowledge and contributed with valuable ideas and feedbacks, and for providing good research networks and arenas. Many thanks to Marina Tonkopeeva at ICR for thorough language washing. This paper was also part of the PhD project “In the smoke of the *lávvu*—a comparative study on ways of knowing about Sámi traditional smoking practices” at UiT – the Arctic University of Norway in Tromsø. We thank UiT for the facilitation and cooperation in connection with our research.

Author Contribution All authors contributed to the study conception and design, but especially Smuk was in the front of initiating the project. Material preparation, data collection and analysis were performed by Krarup Hansen and Sara. The first draft of the manuscript was written by Krarup Hansen, and especially Krarup Hansen and Brattland worked on the introduction and discussion sections. All authors participated in meetings discussing the data and the scope of the paper, and all commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding Open access funding provided by UiT The Arctic University of Norway. This study was funded by the Research Council of Norway as part of the research project “RIEVDAN Rapid change – challenges and/or opportunities for sustainable reindeer husbandry” (grant no. 238326) and the Arctic Council project “EALLU Arctic Indigenous Youth: Traditional Knowledge and Food Culture – Navigation Towards Sustainability through New Approaches for Addressing Arctic Change and Globalisation”. The RIEVDAN and EALLU projects are directed by the University of the Arctic Institute for Circumpolar Reindeer Husbandry at the International Centre of Reindeer Husbandry (ICR) and Sámi Allaskuvla—the Sámi University of Applied Science (SAMAS).

Data Availability Raw anonymized written data are available by contacting the corresponding authors and the International Centre for Reindeer Husbandry (ICR). Photographs, video- and tape recordings are only available after consent by the participants.

Code Availability Not applicable.

Declarations

Ethics Approval This study followed ethical recommendations given by the National Committee for Research Ethics in the Social Sciences and the Humanities in Norway (NESH 2016), the International Arctic Social Sciences Association (IASSA 2020) and Ethical guidelines for handling traditional knowledge at the International Centre for Reindeer Husbandry (Sundset et al. 2007). The study has been approved by the Norwegian Centre for Research Data (NSD), Project #54964.

Consent to Participate Written informed consent was obtained from all key smokers consulted. The consent included information of; the study and its goal of publication; that raw data material would be saved securely and shared within research partners at ICR; that participation is voluntary, and that anonymization is possible.

Consent for Publication The participants have consented to scientific publication of their traditional knowledge of smoking shared through the project.

Competing Interests The authors have no relevant financial or non-financial interests to disclose.

Conflict of Interest The authors declare that they have no conflict of interest.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Battiste, Marie, and James Henderson. 2000. *Protecting Indigenous knowledge and heritage: A global challenge*. Purich: Saskatoon.
- Berkes, Fikret. 1999. *Sacred ecology: traditional ecological knowledge and resource management*. Philadelphia: Taylor & Francis.
- Berkes, Fikret, and Mina Kislalioglu Berkes. 2009. Ecological complexity, fuzzy logic, and holism in indigenous knowledge. *Futures* 41: 6–12. <https://doi.org/10.1016/j.futures.2008.07.003>
- Berkes, Fikret, Johan Colding, and Carl Folke. 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications* 10: 1251–1261.
- Bogoras, Waldemar. 1904. *The Chukchee I. - Material culture*. Leyden: E.J. Brill.
- Burgess, Philip (ed.). 2018. *Indigenous Youth, Food Knowledge and Arctic Change EALLU*. (International Centre for Reindeer Husbandry (ICR) Report 2017:1. Guovdageaidnu/Kautokeino, Norway.).
- Council of Canadian Academies. 2014. 'Aboriginal Food Security in Northern Canada: An Assessment of the State of Knowledge, Ottawa, ON. The Expert Panel on the State of Knowledge of Food Security in Northern Canada, Council of Canadian Academies'.
- Charmaz, Kathy, and Linda Liska Belgrave. 2012. Qualitative interviewing and grounded theory analysis. In *The SAGE handbook of interview research: The complexity of the craft*, ed. Jaber F. Gubrium, James A. Holstein, Amir B. Marvasti, and Karyn D. McKinney, 347–66. Thousand Oaks: SAGE Publications, Inc.
- Cornwall, Andrea and Rachel Jewkes. 1995. What is participatory research? *Social Science and Medicine* 41: 1667–1676.
- Arctic Council. 2015. Ottawa Traditional Knowledge Principles. 'Available (01.05.19) at http://www.saamicouncil.net/fileadmin/user_upload/Documents/Eara_dokumeantat/Ottawa_TK_Principles.pdf'.
- Davis, Anthony, and Kenneth Ruddle. 2010. Constructing confidence: Rational skepticism and systematic enquiry in local ecological knowledge research. *Ecological Applications* 20: 880–894.
- Drake, Sigrid. 1918. *Västerbottens-lapparna under förra hälften av 1800-talet*. Stockholm: Wahlström & Widstrand.
- Eidlitz, Kerstin. 1969. Food and emergency food in the circumpolar area. University of Uppsala.
- Eira, Inger Marie Gaup, Christian Jaedicke, Ole Henrik Magga, Nancy G. Maynard, Dagrún Vikhamar-Schuler, and Svein D. Mathiesen. 2013. Traditional Sámi snow terminology and physical snow classification—Two ways of knowing. *Cold Regions Science and Technology* 85: 117–130.
- Eira, Inger Marie Gaup, Mikkel Nils Sara, Hanne Svarstad, and Svein Disch Mathiesen. 2016. 'Å se som en stat eller som en samisk reinier: To forståelser av bærekraftig reindrift [Seeing as a state or as a Sami reindeer herder: Two understandings of sustainable reindeer husbandry].' in Tor A Benjaminsen, Inger Marie Gaup Eira and Mikkel Nils Sara (eds.), *Samisk reindrift - norske myter [Sami reindeer husbandry - Norwegian myths]* (Fagbokforlaget: Bergen, Norway).

- Eira, Inger Marie Gaup. 2012. 'Muohhtaga jávohis giella : sámi árbevirolaš máhttu muohhtaga birra dálkkádatrivdanáiggis = The silent language of snow : Sámi traditional knowledge of snow in times of climate change', UiT The Arctic University of Tromsø, Faculty of Humanities, Social Sciences and Education.
- Elven, Reidar, and Eli Fremstad. 2018. *Salix – vier, selje og pil i Norge*. Trondheim: NTNU University Museum at the Norwegian University of Science and Technology in Trondheim.
- FAO. 2006. Food Security. *Policy Brief 2*: 1–4.
- FAO. 2009. *FAO and traditional knowledge: The linkages with sustainability, food security and climate change impacts*, 2009. Rome: Food and Agriculture Organization of the United Nations.
- FAO. 2021. The White/Wiphala Paper on Indigenous Peoples' food systems. Rome. <https://doi.org/10.4060/cb4932en>.
- Gordon, Line J., Victoria Bignet, Beatrice Crona, Patrik J. G. Henriksson, Tracy Van Holt, Malin Jonell, Therese Lindahl, Max Troell, Stephan Barthel, Lisa Deutsch, L. Carl Folke, Jamila Haider, Johan Rockström, and Cibele Queiroz. 2017. Rewiring food systems to enhance human health and biosphere stewardship. *Environmental Research Letters* 12: 100201.
- Green, Amanda. 2017. 'Tastes of Sovereignty : An Ethnography of Sámi Food Movements in Arctic Sweden', Dissertation, Oregon State University.
- Guttorm, Gunvor. 2011. 'Árbediehtu (Sami traditional knowledge) - as a concept and in practice', *Working with traditional knowledge / edited by Jelena Porsanger, Gunvor Guttorm*: [59]-76.
- Krarpup Hansen, Kia, Turid Moldenæs, and Svein Disch Mathiesen. 2020. The knowledge that went up in smoke: Reindeer herders' traditional knowledge of smoked reindeer meat in literature. *Polar Record* 55: 460–475.
- Krarpup Hansen, Kia, Issat Turi, Monica A. Sundset, and Svein D. Mathiesen. 2022. Bridging traditional and scientific knowledge on reindeer meat smoking - a pilot study. *International Journal of Circumpolar Health* 81: 2073056.
- Hansen, Lars Ivar, and Bjørnar Olsen. 2014. 'Hunters in Transition An Outline of Early Sámi History.' in David Kirby, Jón Viðar Sigurðsson, Ingvild Øye, Piotr Gorecki and Steve Murdoch (eds.), In the book series: *The Northern World. North Europe and the Baltic c. 400–1700 ad Peoples, Economics and Cultures* (BRILL: Leiden, Boston).
- Håseth, Torunn Thauland, Gudjon Thorkelsson, Eero Puolanne, and Maan Singh Sidhu. 2014. Nordic Products. In *Handbook of fermented Meat and Poultry*, ed. Y.H. Fidel Toldrá, Iciar Astiasarán Hui, Joseph G. Sebranek, and Régine. Talon. West Sussex: Wiley Blackwell.
- IASSA. 2020. 'International Arctic Social Sciences Association (IASSA) Principles and Guidelines for Conducting Ethical Research in the Arctic'. <https://iassa.org/about-iassa/research-principles> (Aug 30th 2021).
- Inuit Circumpolar Council-Alaska (ICC-AK). 2015. *Alaskan Inuit Food Security Conceptual Framework: How to Assess the Arctic from an Inuit Perspective - Summary and Recommendations Report*. Report created as part of 2015 Alaskan Inuit Food Security Conceptual Framework Technical Report'.
- Johnsen, Kathrine Ivsett, Svein Disch Mathiesen, and Inger Marie Gaup Eira. 2017. Sámi reindeer governance in Norway as competing knowledge systems: a participatory study. *Ecology and Society*, 22. <https://doi.org/10.5751/ES-09786-220433>.
- Kaiser, Matthias and Anne Algers. 2016. Food ethics: A wide field in need of dialogue. *Food Ethics* 1: 1–7.
- Kaiser, Matthias, Stephen Goldson, Tatjana Buklijas, Peter Gluckman, Kristiann Allen, Anne Bardsley, and Mimi E. Lam. 2021. Towards post-pandemic sustainable and ethical food systems. *Food Ethics* 6: 1–19.
- Kucera, Bohumil and Ragnar M. Næss. 1999. *Tre. Naturens vakreste råstoff [Tree. Nature's most beautiful raw material]* Oslo: Landbruksforlaget [Norwegian].
- Kuhnlein, Harriet V. 2009. 'Introduction. Why are Indigenous peoples' food systems important and why do they need documentation?' in Harriet V. Kuhnlein, Bill Erasmus and Dina Spigeliski (eds.), *Indigenous Peoples' food systems: the many dimensions of culture, diversity and environment for nutrition and health* (Food and Agriculture Organization of the United Nations, Centre for Indigenous Peoples' Nutrition and Environment: Rome).
- Lindow, Harald. 1924. 'Blandt Eskimoerne i Labrador [Among the Eskimos in Labrador]', *Det Grønlandske Selskabs Aarskrift 1923–24 [In Danish]*.
- Lugo-Morin, Diosej Ramon. 2020. Indigenous communities and their food systems: A contribution to the current debate. *Journal of Ethnic Foods* 7: 6.
- Marcus, George E. 1995. Ethnography in/of the world system: The Emergence of Multisited Ethnography. *Annual Review of Anthropology* 24: 95–117.
- Myking, Tor, Erling Johan Solberg, Gunnar Austrheim, James Speed, Fredrik Bøhler, Rasmus Astrup, and Rune Eriksen. 2013. 'Browsing of sallow (*Salix caprea* L.) and rowan (*Sorbus aucuparia* L.) in the context of life history strategies: A literature review', *European Journal of Forest Research*, 132. <https://doi.org/10.1007/s10342-013>

- Nadasdy, Paul. 1999. The Politics of TEK: Power and the “Integration” of Knowledge. *Arctic Anthropology* 36: 1–18.
- Nakashima, Douglas and Marie Roue. 2002. Indigenous knowledge, peoples and sustainable practice. In *Encyclopedia of global environmental change*, ed. Ted Munn. Chichester: John Wiley & Sons, Ltd.
- NESH. 2016. *Guidelines for research ethics in the social sciences, humanities, law and theology*. Oslo: The National Comitty for Research Ethics in the Social Sciences and the Humanities.
- Nordin-Jonsson, Åsa. 2010. ‘Árbediehtu, samisk kulturarv och traditionell kunnskap [Árbediehtu, Sami cultural heritage and traditional knowledge]’, *CMS skriftserie nr 43. Uppsala [Swedish]*.
- Peloquin, Claude, and Fikret Berkes. 2009. Local knowledge, subsistence harvests, and social-ecological complexity in James Bay. *Human Ecology* 37: 533–545.
- Putten, JozienJobse-van. 1988. Development of Food Preservation. In *Food Conservation - Ethnological studies*, ed. Astri Riddervold and Andreas Ropeid. London: Prospect Books Ltd.
- Reinert, Erik. 2006. The Economics of Reindeer Herding: Saami Entrepreneurship between Cyclical Sustainability and the Powers of State and Oligopolies. *British Food Journal* 108: 522–540.
- Reinert, Erik S., Julie Aslaksen, Inger Marie G. Eira, Svein Mathiesen, Hugo Reinert, and Ellen Inga Turi. 2009. Adapting to climate change in Sámi Reindeer herding: The nation-state as problem and solution. In NW Adger, I Lorenzoni and KL O’Brien (Eds.), *Adapting to climate change: Thresholds, values, governance*. Cambridge University Press.
- Riddervold, Astri, and Andreas Ropeid. 1988. *Food conservation*. London: Prospect Books.
- Riddervold, Astri. 2002. Rapport fra Astri Riddervold som er fadder for Inger Anita Smuks prosjekt under TEFT, om tradisjonell slaktning av rein og preparering av kjøttet ved tørking og røyking [Report from Astri Riddervold who is supervisor for the TEFT project on traditional slaughter of reindeer and preparation of the meat by drying and smoking led by Inger Anita Smuk] [In Norwegian].
- Sahlin, Resare, Elin Rööös. Kajsa, and Line J. Gordon. 2020. ‘Less but better’ meat is a sustainability message in need of clarity. *Nature Food* 1: 520–522.
- Sandelowski, Margarete. 2000. Whatever happened to qualitative description? *Research in Nursing & Health* 23: 334–340.
- Sara, Mikkel Nils. 2009. Siida and traditional Sámi Reindeer herding knowledge. *The Northern Review* 30: 153–178.
- Sara, Ravdna Biret Marja E. and Inger Marie G. Eira. 2021. Addamiin vai jolážiin – boazosápmelaččaid bohccobiergokvalitehta árvvoštallan [Addamiin or jolážiin – Sámi reindeer herders assessment of reindeer meat quality]. *Sámi Dieddalaš Áigečála* 1: 7–38.
- Sara, Ravdna Biret Marja E., Karen Lykke Syse, and Svein Disch Mathiesen. 2022. Precious blood and nourishing offal: Past and present slaughtering perspectives in Sámi reindeer pastoralism. *Pastoralism* 12: 20.
- Sara, Ravdna Biret Marja E. and Svein Disch Mathiesen. 2020. Sámi gastronomy: The role of traditional knowledge. *Journal of Gastronomy and Tourism* 5 (1): 33–49. <https://doi.org/10.37271/216929720X15968961037890>
- Sara, R.B.M.E., K. Krarup Hansen, S.L. Chernyshova, A. Degteva, L.B. Gashilova, A. Gerasimova, E. Okotetto, M. Okotetto, A. Oskal N. Serotetto, I. A. Smuk and S. D. Mathiesen. 2022. The food systems of Arctic Indigenous Peoples. In Svein D. Mathiesen, Inger M. G. Eira, Ellen Inga Turi, Anders Oskal, Mikhail Pogodaev and Marina Tonkopeeva (eds.), *Reindeer husbandry: Adaptation and resilience to a Changing Arctic II*. Springer Polar Sciences.
- Settee, Priscilla, and Shailesh Shukla. 2020. *Indigenous food systems: Concept, cases, and conversations*. Toronto: Canadian Scholars, an imprint of CSP Books Inc.
- Sidik, Saima May. 2022. For better science, increase Indigenous participation in publishing. *Nature*, Jan 10 (2022). <https://doi.org/10.1038/d41586-022-00058-x>.
- Smuk, Inger Anita. 2003. Dokumentasjon av produksjonsprosess på tørking og røyking av reinkjøtt. Sluttrapport for Teft – fadderstipend. Varangerbotn [Documentation of the production process for drying and smoking of reindeer meat. Final report for the Teft - sponsor scholarship. Varangerbotn] [Norwegian].
- Stefánsson, Vilhjalmur. 1914. The Stefánsson-Anderson arctic expedition of the American Museum: Preliminary ethnological report. *Anthropological papers of the American Museum of Natural History*, 14.
- Steingrimsdóttir, Laufey, Guðjón Thorkelsson, and Emma Eythórsdóttir. 2018. Chapter 6 - Food, nutrition, and health in Iceland. In *Nutritional and health aspects of food in Nordic Countries*, ed. Veslemøy Andersen, Eirin Bar, and Gun Wirtanen. Cambridge: Academic Press.
- Stith, Michaela, Rosa-Maren Magga, Matthias Kaiser, Robert Correll, Anders Oskal, and Svein D. Mathiesen. Forthcoming 2022. Ethics of knowledge production in times of environmental change. In Svein D. Mathiesen, Inger M. G. Eira, Ellen Inga Turi, Anders Oskal, Mikhail Pogodaev and Marina Tonkopeeva (eds.), *Reindeer husbandry: Adaptation and resilience to a Changing Arctic*. Springer Polar Sciences.

- Sundset, Monica A., Anders Oskal, and Johan Mathis Turi. 2007. *Ethical guidelines for handling traditional knowledge at the International Centre for Reindeer Husbandry*. Guovdageaidnu/Kautokeino: Board Policy Document of International Centre for Reindeer Husbandry.
- Turi, Ellen Inga. 2016. *State steering and traditional ecological knowledge in Reindeer-Herding governance: Cases from western Finnmark, Norway and Yamal, Russia*. Umeå University.
- Turner, Lucien M. 1894. *Ethnology of the Ungava District, Hudson Bay Territory*. Government Printing Office: Washington.
- Virtanen, Pirjo Kristiina, Laura Siragusa, and Hanna Guttorm. 2020. Introduction: Toward more inclusive definitions of sustainability. *Current Opinion in Environmental Sustainability* 43: 77–82.
- WCED. 1987. *Our common future. The World Commission on Environment and Development*. New York: Oxford University Press.
- Willett, Walter, Johan Rockström, Brent Loken, Marco Springmann, Tim Lang, Sonja Vermeulen, Tara Garnett, David Tilman, Fabrice DeClerck, Amanda Wood, Malin Jonell, Michael Clark, Line J. Gordon, Jessica Fanzo, Corinna Hawkes, Rami Zurayk, Juan A. Rivera, Wim De Vries, Lindiwe Majele Sibanda, Ashkan Afshin, Abhishek Chaudhary, Mario Herrero, Rina Agustina, Francesco Branca, Anna Lartey, Shenggen Fan, Beatrice Crona, Elizabeth Fox, Victoria Bignet, Max Troell, Therese Lindahl, Sudhvir Singh, Sarah E. Cornell, K. Srinath Reddy, Sunita Narain, Sania Nishtar, and Christopher J. L. Murray. 2019. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*. [https://doi.org/10.1016/S0140-6736\(18\)31788-4](https://doi.org/10.1016/S0140-6736(18)31788-4).
- Yua, Ellam, Julie Raymond-Yakoubian, Raychelle Aluaq Daniel, and Carolina Behe. 2022. A framework for co-production of knowledge in the context of Arctic research. *Ecology and Society*, 27. <https://doi.org/10.5751/ES-12960-270134>.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.