History of Medicine, 2019, 6(2): 63–69
DOI: 10.17720/2409-5834.v6.2.2019.01a

# From the history of the study of the diet in North-Eastern Siberia: from the paleo diet to Coca-Cola in just 100 years*

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**Received:** 21 May 2018 **Accepted:** 06 May 2019 **Published online:** 15 July 2019

**Citation:** Tikhonov DG, Lebedeva UM, Stepanov KM (2019) From the history of the study of the diet in North-Eastern Siberia: from the paleo diet to Coca-Cola in just 100 years. History of Medicine 6(2): 63–69. https://doi.org/10.17720/2409-5834.v6.2.2019.01a

**Abstract**

The work attempts to reconstruct the chemical composition and energy value of the diet in Yakutia based on data provided by A. Middendorff (1842–1845) and V. Seroshevsky (1896). Our study enabled to establish the daily diet of pastoralists in the first half of the 19th century (prior to the introduction of bread into the diet of this region) and the late 19th century (during the transitional period, which is associated with the introduction of crop farming and an increase in the consumption of flour-based foods).

The diet of the affluent segment of the population of Yakutia in the pastoral period (before the second half of the 19th century) can be described as a protein-fat diet, dominated by protein and fat with low carbohydrate content. Fat metabolism is a key element of adaptation in a cold climate. Hence the high-fat content of the diet served as an advantage for adaptation for the pastoralists when settling in North-Eastern Siberia with its extremely cold climate. This circumstance is one of the primary conditions which facilitated extensive expansion of the pastoral population of Yakutia in North-Eastern Siberia in the 17th–19th century.

The introduction of crop farming in the region was characterised by a change in the diet of the residents of the region (pine tree sap was replaced with flour-based foods). The reconstruction of the diet showed that during this period, the diet in Yakutia resembled the so-called paleo diet. However, over the past 100 years, the diet in North-Eastern Siberia has drastically changed from a paleo diet to a post-industrial diet, which has affected the health of the population.

**Keywords**

history of health care, regional history of medicine, nutrition, protein-fatty type, paleo diet, pine sapwood, diabetes, cardiovascular diseases

In the late 20th century, traditional characteristics of the diet of the indigenous population of northern regions, which was established over a long period of time, began to undergo significant changes. The exact changes in the chemical composition of the diet and its energy value during the modernisation of the diet in Yakutia have not been established. Also, no information on the diet of this region during the pastoral period has been provided.

In this study, we attempted to reconstruct the chemical composition and energy value of the diet in Yakutia during the early Middle Ages based on data provided by A. Middendorff (1842–1845) (Middendorff 1869) and

* The work was carried out as part of the base project of the Ministry of Science and Higher Education of the Russian Federation, code: 0794-2017-0016, NIR No. FSRG-2017-0016 and the science project of the Russian Foundation for Basic Research No. 17-21-08001.

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**Table 1.** Amount of food consumed by a wealthy Yakut family per day in the 1840s (before the mass introduction of bread into the diet)*

| Product | Amount of product, unit of measurement | | Average estimates of consumed products* | |
|---|---|---|---|---|
| | from | to | In an average family per year, kg | Per family per day, g |
| Tea | 20 pounds | 30 pounds | 10.238 | 2.80 |
| Refined sugar | 40 [pounds] | 80 [pounds] | 24.571 | 6.73 |
| Vodka | 5 buckets | Or more | 61.497 l | 53.24 |
| Colt meat** | 15 poods | Or more | 202.5* | 554.8* |
| Horse meat*** | 15 poods | Or more | 201.7* | 552.6* |
| 1st category beef*** | 10 poods | 15 poods | 157.3* | 431.0* |
| 2nd category bee[f*)) | 10 poods | 15 poods | 151.3* | 414.5* |
| "Krestyanskoe" unsalted butter | 5 [poods] | 7 [poods] | 98.283 | 268.53 |
| Clarified butter | 10 [poods] | 15 [poods] | 204.756 | 559.44 |
| Curd cheese | 25 poods | | 409.512 | 1118. 89 |

Note. The results were calculated: *based on data from A. Middendorff (Middendorff 1869), **taking into account data from P. Gogoleva (Pankratov 2013), *** based on data from A.I. Zdobnov, V.A. Tsyganenkov (Sbornik retseptur blyud... 2009). Technical losses during dressing and storage of the product for ** and *** were calculated as a % based on (Abramov et al. 2006).

**Table 2.** Amount of food consumed per capita per day in the late 19th century (North-Eastern Siberia, Yakutia)*

| Product | Amount of product, unit of measurement | | Average estimates of consumed products | |
|---|---|---|---|---|
| | from | to | Per family, per year, kg | Per capita per day, g |
| Natural and skimmed milk: | 140 poods | 200 poods | 2784.7 | 1695.0 |
| Skimmed milk | | | 2702.6 | 1645.0 |
| Kerchekh (whipped cream) | | | 82.1 | 50.0 |
| Tar | 45 poods | 50 poods | 778.1 | 474.0 |
| Butter | 2 poods | 3 poods | 41.0 | 25.0 |
| Bread | 5 poods | 30 poods | 286.7 | 175.0 |
| Plant substitutes: | 100 poods | 10 poods | | |
| pine tree sap | | | 900.9 | 548.0 |
| glowering rush** | | 1 pood | 16.4 | 9.0 |
| lingonberry** | | 1 pood | 16.4 | 9.0 |
| Fish | 20 poods | 10 poods | 245.7 | 132.0 |
| 1st category beef | 2 poods | 2.5 poods | 31.53 | 19.23 |
| 2nd category beef | 2 poods | 2.5 poods | 30.33 | 18.43 |
| Beef tallow | 0.5 pood | 1 pood | 12.3 | 7.0 |
| Tea | 8 brickss | 10 bricks | 4.5 | 2.5 |
| Sugar | - | 5 pounds | 1.0 | 0.6 |
| Vodka | - | 0.25 bucket | 1.5 l. | 0.8 |

Note. *Calculations based on data from V. Seroshevsky (Seroshevsky 1993). ** Our estimates.

V. Seroshevky (1896) (Seroshevsky 1993). Based on official statistics, we also sought to analyse the change in the composition of food nutrients over the past 23 years.

A. Middendorff cites all data on the energy value and chemical composition of the diet per family (Middendorff 1869, see Table 1), but does not indicate the number of family members (the family is only described as "wealthy"). In light of this, we assume that the family consisted of 4–5 people. A. Middendorff lists the products (Table 1), and also indicates that besides the listed products, the diet also included "fish, game, etc, flour on rare occasions" (Middendorff 1869).

The amount of meat consumed is based on the product yield from dressing carcasses, excluding bones and losses from dressing and storage of the carcasses (connective tissue is classified as the edible portion of the product, taking into account local traditions; see (Abramov et al. 2006). We divided horse meat and beef

**Table 3.** Chemical composition of the known part of the diet of a wealthy family in Yakutia before the widespread introduction of crop farming (the 1840s), calculations based on data from A. Middendorff (Middendorff 1869)

| Name of product | Weight, g | Protein, g | Fat, g | Carbohydrates, g | Cholesterol mg% | Fibre |
|---|---|---|---|---|---|---|
| Tea | 2.80 | 0.6 | 0.1 | 0.1 | - | - |
| Refined sugar | 6.7 | - | - | 6.7 | - | - |
| Vodka | 154.3 | - | - | 0.6 | - | - |
| Colt meat | 554.8 | 118.2 | 78.8 | - | 332.9 | - |
| Horse meat | 552.6 | 115.5 | 22.7 | - | 276.3 | - |
| 1st category beef | 431.0 | 80.2 | 69.0 | - | 344.8 | - |
| 2nd category beef | 414.5 | 82.9 | 40.6 | - | 290.2 | - |
| Butter | 268.5 | 2.1 | 194.7 | 3.5 | 456.5 | - |
| Clarified butter | 559.4 | 1.1 | 553.8 | - | 1230.68 | - |
| Curd cheese | 1118.9 | 33.6 | 0.6 | 42.5 | - | - |
| Total per family (average size of family - 4.5 people) | 2110.6 | 434.2 | 960.3 | 53.4 | 2931.38 | - |
| Per person | 469.0 | 96.5 | 213.4 | 11.9 | 651.4 | 0 |

into two categories – the 2nd category horse and colt meat, and beef – into the 1st and the 2nd category, based on nutritional state.

V. Seroshevsky's data enable to calculate the diet per person in the period of a complete transition to flour-based foods (the golden age of crop farming in North-Eastern Siberia, the second half of the 19th century). The number of family members is taken as 4–5. The authors of the article determined the amount and composition of plant substitutes using a judgement-based technique.[1] We employed professional literature (Khimicheskiy sostav... 1987, Khimicheskiy sostav... 2002, Abramov et al. 2006, Lebedeva and Abramov 2015, Rautio et al. 2013) when calculating the chemical composition and energy value of the daily diet in Yakutia in the second half of the 19th century.

V. Seroshevsky's data on food consumption in pastoralist districts in middle-class families, consisting of 4–5 members, are given in Table 2.

The most archaic element of the diet of the region is pine tree sap. Its consumption is common among the peoples of the circumpolar region – from the Scandinavians (Rautio et al. 2013) to territories far from Ural, as well as in Alaska and Canada (British Columbia).

In the calculations, the old Russian measurement system, used by A. Middendorff and V. Seroshevsky, was converted to the SI system.[2]

The results of the calculation of the chemical composition of the diet in Yakutia based on data from A. Middendorff (Middendorff 1869) and V. Seroshevsky (Seroshevsky 1993) are given in tables 3 and 4. According to the obtained data, before the introduction of crop farming in Yakutia, the daily diet of wealthy pastoralists in the first half of the 19th century primarily consisted of fat with minimal carbohydrate content. By our estimates, the energy value of part of the daily diet (excluding fish, game, etc) reached 2354 kcal per person, and taking into account the excluded part of the diet, the energy value almost matched that of the diet of the northern population of the region. Amid the mainstreaming of crop farming in Yakutia, the chemical composition of the diet in this region in the late 19th century changed significantly, although the archaic elements of the diet remained. Our calculations showed that the energy value of this diet in the late 19th century was 2225 kcal. The daily diet consisted of 115 g protein, 65 g fat and 241 g carbohydrates (Table 4), which differed from the northern diet by its relatively low energy value and low specific weight of fats and carbohydrates, but high protein content. Another peculiarity of the diet in Yakutia in the 19th century was its high content of plant fibre (134.0 g daily).

Basic statistical data for 1994–2016 on the composition of food nutrients were obtained from official published sources in the Republic of Sakha (Yakutia)[3] (see Figure 1).

[1] It should be noted that the use of pine tree sap peaked during the famine years and dropped to a minimum during normal years.

[2] Conversion of Russian measurements to SI: 1 pood – 16.3804964 kg, 1 Russian pound – 409.512037 g; 1 bucket– 12.29941 l; 1 brick tea (Chinese) – 2 kg.

[3] State Statistics Committee of the Russian Federation, State Statistics Committee of the Republic of Sakha (Yakutia). Standard of living in the Republic of Sakha (Yakutia) for 1992–1997, Yakutsk, 1999. P. 43; State Statistics Committee of the Russian Federation, State Statistics Committee of the Republic of Sakha (Yakutia). Standard of living in the Republic of Sakha (Yakutia) for 1990, 1995–2000, Yakutsk, 2001. P. 55; Russian Federal State Statistics Service (Rosstat). Food consumption in households, 2008–2016. Http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1140095125312 Released 30.01.2018; Russian Federal State Statistics Service. The regional office of the Federal State Statistics Service for the Republic of Sakha (Yakutia). Social status and standard of living in the Republic of Sakha (Yakutia). Yakutsk, 2007. 138 p.

**Table 4.** Chemical composition of the daily diet in Yakutia in the second half of the 19th century, calculations based on data from V. Seroshevsky (Seroshevsky 1993)

| Name of product | Total, g per capita per day | Protein, g | Fat, g | Carbohydrates, g | Cholesterol | Food and plant fibre |
|---|---|---|---|---|---|---|
| Natural and skimmed milk: | 1695.0 | | | | | |
| – skimmed milk | 1645.0 | 49 | 0.8 | 77.3 | 0 | - |
| – kerchekh (whipped cream) | 50.0 | 1.3 | 17.5 | 1.5 | 70.0 | - |
| Tar | 474.0 | 14.2 | 0.2 | 18.0 | - | - |
| Butter | 25.0 | 0.2 | 18.1 | 0.3 | 42.5 | - |
| Bread | 175.0 | 14 | 2.6 | 70.2 | - | 12 |
| Plant substitutes: | | | | | | |
| – pine tree sap | 548.0 | 4.4 | 11.5 | 70.1 | - | 121 |
| – glowering rush | 9.0 | 1.0 | 0.5 | 2.4 | - | 1 |
| – lingonberry | 9.0 | 0.1 | - | 0.7 | - | - |
| Fish | 132.0 | 23.4 | 2.4 | - | 66 | |
| 1st category beef | 19.24 | 3.6 | 3.1 | - | 15.4 | |
| 2nd category beef | 18.44 | 3.7 | 1.8 | - | 12.9 | |
| Beef tallow | 7.0 | - | 7.0 | - | 7.7 | |
| Tea | 2.5 | 0.5 | 0.1 | 0.1 | - | |
| Sugar | 0.6 | - | - | 0.6 | | |
| Vodka | 3.8 | - | - | - | - | |
| Total | 3118.58 | 115.4 | 64.8 | 241.2 | 214.5 | 134 |

The diet in the early periods[4] can be reconstructed indirectly using the results of ethnographic, archaeological and other studies, along with a study of the eating habits of modern hunter-gatherers (Konner and Eaton 2010). In this respect, studies conducted by A. Middendorff in 1842–1845 during his expedition in Siberia, as well as studies conducted by V. Seroshevsky (late 19th century) are valuable historical sources for the reconstruction of the chemical composition of the diet in North-Eastern Siberia during the pastoral and crop farming periods. It should be noted that the available literature lacks data on the chemical composition of the diet of this region in said period.

The average figures on the chemical composition of the diet of the affluent segment of the pastoral population that we found show high fat content in ensuring the energy balance of the body and a very high energy value of the diet overall. This circumstance is one of the primary conditions which facilitated extensive expansion of the pastoralist population of Yakutia in North-Eastern Siberia in the 17th–19th century (Parnikova 1998, Tikhonov et al. 2019). Fat metabolism is a key element of adaptation in a cold climate (Panin 1978, Cardona et al. 2014), which makes high fat content of the diet an advantage when settling in North-Eastern Siberia with its extremely cold climate. The diet of the indigenous populations of northern territories described by a number of researchers is characterised by high specific weight of protein and fat, with relatively low carbohydrate content (Khaldeev 1924, Tikhonov et al. 2019).

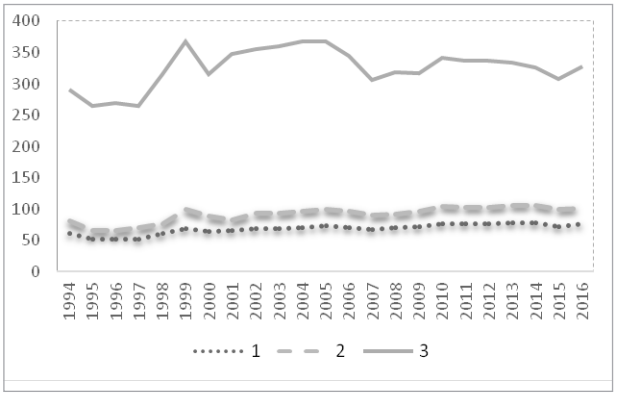


**Figure 1.** Content (in grams) of proteins (1), fats (2) and carbohydrates (3) in the diet in Yakutia in 1994–2016.

The most accurate and complete picture of the diet of the region in the late 19th century is described in V. Seroshevsky's (Seroshevsky 1993) work. Estimation of the chemical composition of the diet in this period showed that it matches the characteristics of a paleo diet (Konner and Eaton 2010) (Table 5).

The diet of the wealthy segment of the population of Yakutia is associated with a protein-fat diet vastly dominated by fat. In terms of carbohydrates, it matches the diet of marine hunters (Inuits; see Table 5). The protein-fat diet developed as humans adapted to the Northern environment. It should be noted that this type of diet is ideal for the hunter-gatherer lifestyle and arose from battling cold and hunger. In modern-day conditions of surplus food, lifestyle changes and everyday comfort, the price paid by the indigenous population of the region for giving up traditional foods and for adaptation to the new diet was the ex-

[4] This pertains to the pre-literate period (before joining the Russian Empire).

plosive increase in cases of cardiovascular diseases and sugar diabetes.

In terms of content of protein, fat, carbohydrates and fibre, the diet in Eastern Siberia in the early stages of modernisation of crop farming closely matched the so-called paleo diet. Today, the paleo diet is recommended for lowering the risk of sugar diabetes and cardiovascular diseases (Klonoff 2009). In the early period of modernisation of crop farming in Yakutia, the incidence of cardiovascular diseases was low and the pathological profile of the population was characterised by the domination of infectious diseases (Tikhonov 2010) in the mortality and morbidity patterns. K.R. Sedov, a renowned research scientist in the field of health in polar latitudes in the 1960–1970s and a member the USSR Academy of Medical Sciences, claimed there had been no reported cases of sugar diabetes (Sedov 1994) among the Evenkis based on field research in the village of Topolinoe in Yakutia.

called the period of Coca-Cola colonisation. It should be noted that consumption of this beverage in Russia in 1991 (at the collapse of the Soviet Union) was 1 can per capita (8 fluid oz or 236.6 l), and by 2011 it had reached 73 cans.[5] The consumption of protein, fat and carbohydrates in the Republic of Sakha (Yakutia) grew rapidly until 2005, but since then there has been no steady increase in the consumption of said nutrients (Table 5). Coca-Cola sales in Russia have not risen since 2010, which is partly the result of some consumers turning to healthy foods.[6] The steady consumption of nutrients by the population in Yakutia since 2005 is not only due to economic reasons, but also rampant cardiovascular diseases (Tikhonov et al. 2011) and type 2 sugar diabetes in this region. The incidence of type 2 sugar diabetes in Yakutia, according to the republic's medical information analytical centre, increased from 0.4 to 3.2 per 1000 people (i.e., eight-fold) from 1994 to 2013.

**Table 5.** Proportion of nutrients in the diet in Yakutia before and after the modernisation of the diet as a result of the introduction of crop farming (as a % to the total energy value of the diet)

| **Name of diet** | **Name of nutrient** | | | | | **Source** |
|---|---|---|---|---|---|---|
| | Protein, g | Fat, g | Carbohydrates, g | Cholesterol (mg) | Food and plant fibre | |
| Paleo diet | 25-30 | 20-35 | 35-40 | +500 | >70 | (Konner and Eaton 2010) |
| Marine hunters (Inuits) | 44.0 | 47.0 | 8.0 | - | - | (Stepanov et al. 2014, Kozlov et al. 2007) |
| Pastoralist | 15.9 | 78.9 | 5.2 | 651.4 | 0 | Present study |
| Early stage of modernisation of crop farming | 23 | 29 | 48 | 214.5 | 134.0 | Present study |
| At the beginning of Soviet modernisation (1921-1923) | 17.3 | 27.9 | 54.8 | | | (Khaldeev 1924) |
| Post-Soviet modernisation period (present day) | 12.1 | 36.6 | 51.3 | | | Rosstat data* |
| Standard average daily physiological requirement | 12.0 | 29.6 | 58.4 | 300 | 30 | (Lebedeva and Abramov 2015) |

Note. *Russian Federal State Statistics Service (Rosstat). Food consumption in households 2008–2016.[7]

In the Soviet era, steady supply of food in the Far North was achieved only in the 1960s as a result of the "westernisation" (or "Europeanisation") of the diet of the indigenous population of this region. One of the significant benefits of this development was the "eradication of hunger – the permanent companion of the past" (Khaldeev 1924).

According to the data we obtained, in the post-Soviet period (from 1994 to 2016), the energy value of the diet in Yakutia increased by 15.8%, protein content increased by 20.7%, fat content by 20.4% and carbohydrate content by 11.4%. This period can be

Therefore, the diet of the indigenous population in North-Eastern Siberia has undergone three waves of

[5] Coca Cola. Per capita consumption of company beverage products. Access mode: https://www.coca-colacompany.com/annual-review/2011/pdf/2011-per-capita-consumption.pdf.

[6] Trutnev O., Afanasyeva A. Coca-Cola bets on Zero. Coca-Cola to end Coke Light sales in Russia. Kommersant. 2015; 90: 1 (https://www.kommersant.ru/doc/2734200)

[7] See: http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1140095125312 Released 30.01.2018.

modernisation over the past 100 years. The first one was associated with the introduction of crop farming in the region (roughly starting from the second half of the 19th century). In 1896, V. Seroshevsky wrote: "Yakuts in the southern uluses now eat bread every day; and there was a time, as is the case in the Kolymsky and Verkhoyansky uluses now, when Yakuts could not eat bread: they said it gave them heartburn. And their stomachs are still unable to properly digest barley flour. <...> This rapid change, in just 30–40 years, would certainly have been too fast for the stomachs of Yakuts; they were not prepared for it by previous consumption of flour substitutes and pine tree sap" (Seroshevsky 1993). The second wave of the modernisation of the diet is associated with the period of the establishment of Soviet power (Kozlov et al. 2007) in the region, and was referred to as westernisation. The third wave was the transition to the post-industrial economic order and coincided with the collapse of the Soviet Union (Professor P. Zimmet called this period "coca-colonisation") (Zimmet 2000).

The type of the diet of the affluent segment of the population of Yakutia in the pastoral period was protein-fat (dominated by protein and fat with low carbohydrate content). Unlike the hunter-gatherer diet in the northern territories, the diet of pastoralists in Yakutia was characterised by very high fat content due to the introduction of dairy products and butter. Fat metabolism is a key element when adapting to a cold climate. The high content of fat in the diet gave pastoralists an advantage when settling in North-Eastern Siberia, which is characterised by an extremely cold climate. This circumstance is one of the primary conditions which facilitated extensive expansion of the pastoralist population of Yakutia in North-Eastern Siberia in the 17th–19th century.

The introduction of crop farming in the north-east of the Asian continent was characterised by a change in the diet of the residents of the region with replacement of pine tree sap with flour-based foods. The reconstruction of the diet in Yakutia based on data provided by V. Seroshevsky showed that the diet of this region during the transitional period matched the paleo diet.

The post-industrial modernisation of the diet of the region (coca-colonisation era) coincided with the fall of the Soviet Union and led to an increase in the energy value of the diet due to an increase in consumption of protein, fat and carbohydrates from 16% to 21%. To a certain extent, the result of these changes was the explosive increase in the incidence of cardiovascular diseases and sugar diabetes in the region.

Therefore, in 100 years (a relatively long period a historical perspective) the population of North-Eastern Siberia made the transition from a paleo diet to a post-industrial diet (coca-colonisation according to P. Zimmet). The explosive increase in the incidence of cardiovascular diseases and sugar diabetes in the region can be regarded as the price for adaptation to the extreme conditions of the region and the traditional way of life.

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