

Equipment for Activities at Outside Temperatures of -50°C

II. Nutrition

It is a basic rule of almost all expeditions where physical work and harsh conditions dictate the daily routine: "If there is enough and a variety of food, conflicts among group members are less likely to occur". Not obeying this rule was the cause for failure of many polar expeditions. There is a lot of literature of expeditions, during which team members became psychologically unable to cope with the harsh conditions, partly because the diet was not well planned. It is not a problem to live on frozen fish, ham and bread for several weeks at low temperatures – one may even stay fit – but a lot of times this monotonous diet becomes problematic in larger groups during long-term trips.

If one is active in cold temperatures the nutritional requirements change: In addition to the basic nutrition needs of 1500 kcal per day there will be an additional 2000 kcal for sportive activity, and an additional 2000 kcal per day due to cold temperatures. That makes a total of 5500 kcal per day that needs to be accounted for at temperatures of -50°C when being physically active. Of course this amount of food should be minimal in weight and have a small volume. During a three-months cycling winter expedition to Greenland in 1992 (<http://www.mountainbike-expedition-team.de/Greenland/greenland.html>), the 5500 kcal per day made up 1.2 kg including packaging. This diet plan was so successful, that modifications were used equally successful for several other expeditions into colder regions (Mongolia, Tibet, Siberia).

Breakfast

... should consist of a portion of 200 g cereal-mix (Müsli). This is a suggestion for my favorite mixture for cold regions. It is calculated for a total of 10 kg, equaling 50 daily rations.

It is possible to add additional varieties of dried fruit to the mixture depending on taste. It is not included in the mixture yet. Also, variations are possible depending on the availability and personal taste.

item:	kcal/100g	percentage (%)	amount for 10kg (g)	kcal total
oat crispies	382	5	500	1910
oats	352	15	1500	5280
crunchy oats	448	20	2000	8960
cornflakes	355	10	1000	3550
oats made of rye	307	6	600	1842
raisins	266	5	500	1330
coconut flakes	606	2	200	1212
sesame seeds	574	5	500	2870
flax seeds	393	2	200	786
sunflower seeds	596	8	800	4768
almonds, cut	577	8	800	4616
hazelnuts, cut	647	8	800	5176
walnuts, cut	666	4	400	2664
banana chips	326	2	200	652
dried fruit.	250	+X	+X	+X
		100 %	10 kg	45616 kcal
in addition:				
grease/oil	898	+	1000	8980 kcal
whole milk powder	493		2500	12325 kcal

Total amount: 13.5 kg

total calories: 66921 kcal

One ration (200 g) has approximately **1000 kcal (495 kcal / 100 g)**, without dried fruit.

Oats and other cereal flakes still contain a lot of water, even though they seem dry. This water needs to be removed before preparing the cereal mix. To do this, one can replace the water with higher energy oils by carefully frying the oats in oil or melted butter. With this simple trick, oats and other flakes contain more calories.

To prepare the ration of cereal mix on tour, one should add approximately 3 tablespoons of whole milk powder (50g), and then add hot water. It is not recommended to add the milk powder to the cereal mix beforehand. In addition, one can add some vitamin C, or chocolate powder. If dried fruit are to be added, it is recommended to soak them in hot water first, before adding to the breakfast. You have to eat fast, at temperatures of -50°C it will freeze quickly.

To drink, we like a hot tea, for instance instant lemon tea. Tea bags have too much volume and create too much waste, a classic tea sieve will freeze. Therefore any kind of instant tea (or coffee) is best.

Instant lemon tea has **350 kcal / 100g**.

One needs 6 teaspoons per 1 liter of water, that is approximately 75 g

Lunch / during the day

After the suggested rich breakfast one is o.k. for a few hours. It is recommended to take a little snack about three hours after breakfast, a bigger lunch break is suggested two hours after that (five hours after the breakfast meal), and additional snack breaks every two hours throughout the afternoon. Of course, the number of eating breaks and the amount of food taken during the day will depend on activity and day length. Here we present recipes and diet plans that include for self-made energy bars, mixture of nuts and fruit, marzipan, pemmikan, instant baby food, dried fruit mix, chocolate, etc.

Recipe for energy bars with nuts for 50 days (120 g per person per day), that is 6 kg ingredients

item:	amount (g)	kcal/100g	kcal total
dried fruit, cut into small cubes	2500	250	6250
whole milk powder	900	493	4437
fine oats	400	352	1408
honey	1300	327	4251
syrup from sugar beet, or maple syrup	500	350	1750
coconut flakes	200	606	1212
hazelnuts, finely ground	100	647	647
almonds, small pieces	100	577	577
in addition:			total calories: 20532 kcal
3 teaspoons cinnamon			
100 mL rum			
Vanilla powder			

One 120 g bar has **410 kcal (342 kcal / 100 g)**

All ingredients are being mixed well. The honey should be a crystallized variety that will hold together the other ingredients. However, it should be melted before adding it to the mixture. The dough is then spread on a large baking form in a layer of about 5 cm and is baked at 50°C for 30 min. Only when it is cooled down, you can cut the whole thing into ratios of 50 g pieces. It is also possible to add a layer of melted chocolate to get chocolate-coated energy bars. The cut out bars can then be stored in plastic bags. A layer of cellophane should separate the individual bars, otherwise they would stick to each other.

Other energy bars (z.B. [UltraBars](#), or PowerBars) have a smaller volume and thus are ideal if packaging volume becomes limiting. They also are ideal to have something ready for small snacks. UltraBar: 388 kcal/100g, **one bar (30 g) has 116 kcal**, three bars **348 kcal**

Trail mix of different nuts

item:	kcal/100 g	%	g / 1 kg	kcal total
raisins	260	10	100	260
small raisins	266	10	100	266
pumpkin seeds	560	6	60	336
almonds	577	19	150	866
hazelnuts	647	19	150	971
walnuts	666	12	120	799
cashew	569	10	100	569
pistacias	618	6	60	371
peanuts	570	1	50	285
banana chips	326	1	50	163
pine seeds	674	6	60	404

Totale amount: 1000 g **total calories: 5290 kcal (529 kcal / 100 g)**

Per day and person, we recommend 50 g (**264 kcal**). 1000 g are enough for 20 days

Dried fruit and chocolate

A mixture of dried fruit (**250 kcal / 100 g**) can be put together depending on taste. A variety of fruit are suitable for being dried: Pineapple, cherry, strawberries, apples, pears, plums, mangoes, raspberries, etc. If you are going to prepare dried fruit yourself, you can further reduce the packing volume by meshing the fruit and drying the meshed fruit in a layer of 1 cm. It will become a 2 to 3 mm thick fruit leather. It can be folded or rolled and you can add spices like cinnamon or a scent of rum. We recommend a daily ration of dried fruit of approximately 20 g per day and person that equals about **50 kcal**.

Chocolate is ideal, it gives a necessary dose of sugar, and can be of psychological value in many unpleasant situations. Chocolate has **526 kcal / 100 g**.

Marzipan

Marzipan is a compact and energy-rich paste consisting of almonds (66%) and sugar (33%). It is ideal as an in-between meal or snack. It can be cut into slices, similar to bread. Recommended rations: 50 g per person per day (**266 kcal**)

item:	kcal/100g	amount (g)	kcal total
almonds	577	1500	8655
sugar (finely ground sugar)	400	500	2000

Total amount 2000 g **total calories: 10655 kcal (532 kcal / 100 g)**

To prepare the marzipan, you first need to remove the brown skin from the almonds. To do this, the almonds are being boiled in hot water for 10 minutes and then the skin can easily be removed. Then, the almonds need to be ground – the finer the better. Add sugar to the ground almonds and mix well. The oil of the almonds and the sugar will keep the whole mixture together. You need to press it very hard, until you get a homogenous dough that will stick together. Make blocks of 500 g. The addition of vanilla sugar or orange extract gives a special flavor.

Pemmikan

Pemmikan is traditional travel food of North American Indians. There are a variety of recipes around. We like to use this one:

item:	kcal/100g	amount (g)	kcal total
dried and powdered meat (beef)	370	1300	4810

brown sugar	400	130	520
drie berries (*)	210	140	294
roasted onions (**)	198	130	257
lard from pork	898	800	7184
Total amount: 2500 g			total calories: 13065 kcal (522 kcal / 100 g)

(*) recommended: blueberries, cranberries, red/black currants

(**) cut onions into fine cubes and roast them in a frying pan

It is best to start with minced meat, which can easily be dried. Once it is dry, one can start to grind the pieces to a more fine powder. Berries and sugar are added to the dry meat and mixed well. Melt the grease and add to the mixture of meat, sugar and berries until it becomes a sticky dough. Now you can form rations and let the grease cool down so that it keeps everything together. For longer storage we do not recommend to store it in plastic bags. Rather we put the pemmikan into small cotton bags sew them closed and seal them by dipping them into melted bee wax. Recommended daily ration: 50 g per day (**261 kcal**). If you don't want to eat the whole ration for lunch, you can add it to the evening meal.

Instant baby food

Yes, it seems a bit strange... There is a variety of different flavors of instant fruit meals that are actually designed for small kids. The nice thing about them is that they are ready to go by adding hot water, and they contain supplemented vitamins and minerals and they have an ideal weight to volume ration. In addition, they are cheap compared to "instant trekking meals". Usually they come in 300 g packages and contain **430 kcal / 100 g**.

A daily ration could consist of 300 g of this instant powder dissolved in 1 L of warm water – a kind of an energy drink with fruit flavor...

For the evening meal ...

... we first recommend a hot soup. It is therefore useful to carry enough instant broth cubes. Of course these instant soups don't make up the taste of a fresh vegetable soup and basically consist of flavor and some salt. The good thing is, they are ready in no time and one can feel warm from the inside.

If your expedition has a large enough budget, you can go with the variety of instant meals that are available from various suppliers (<http://www.trekking-mahlzeiten.de>). These freeze-dried ready to go meals have approximately **350 kcal / 100 g**. One person shall eat a 200 g portion, that is **700 kcal** per meal.

Alternatively (and much cheaper!), one can cook small pasta, rice or instant meshed potatoes. One person needs 250 g pasta (**362 kcal / 100 g**) or 170 g rice (**344 kcal / 100 g**) or 150 g meshed potato powder (**344 kcal / 100 g**). It may well be that these rations are too high at the beginning of the tour, but with time the body adapts to the higher energy requirements. To the carbohydrate basis, we add a mixture of dried vegetables (30 g per person per day; approximately **450 kcal / 100 g**).

The dried vegetable mix has to be cooked for 2 to 3 minutes before adding pasta, rice or meshed potato powder. Don't forget salt and spices. Just before the meal is ready, add 2 to 3 tablespoons of oil (sunflower oil or olive oil). In cold temperatures, even oil may solidify, so that it may be good to carry oil in small gelatin capsules, which can be added to the meal.

For dessert we usually prepare 500 g of pudding (one package) with 50 g whole milk powder (together **105 kcal / 100g**). Don't forget to add four tablespoons of sugar (400 kcal / 100 g). Sometimes we have soaked dried fruit with the pudding. Altogether the dessert is **550 kcal** per person.

Total intake of calories per day and person

	<i>Ration</i>	<i>kcal individual</i>	<i>kcal total</i>	
morning:	200 g cereals (+dried fruit)	1000 kcal		
	500 mL tea (= 30 g powder)	90 kcal		
			1090 kcal	
during the day:	120 g nut-energy bars	410 kcal		
	60 g commercial energy bars	232 kcal		
	50 g trail mix	264 kcal		
	15 g dried fruit	50 kcal		
	50 g chocolate	263 kcal		
	50 g marzipan	266 kcal		
	50 g pemmikan	261 kcal		
	300 g instant baby fruit meal	1300 kcal		
			3046 kcal	
evening:	200 g instant meal	700 kcal or		
	250 g pasta	905 kcal or		
	30 g dried vegetable mix	135 kcal		
	170 g rice	584 kcal or		
	30 g dried vegetable mix	135 kcal		
	150 g meshed potato powder	501 kcal or		
	30 g dried vegetable mix	135 kcal		
	Approximately 773 kcal in average per evening meal			
	250 g pudding	550 kcal		
	500 mL tea (= 30 g powder)	90 kcal		
			1413 kcal	
total daily calories:			5549 kcal	