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ENERGY REQUIREMENT FOR COOKING FOOD.

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It is well known that cooking at heights of a few thousand feet and above takes a very much longer time than required on the plains**. This is obviously due to the fact that as we go up, the atmospheric pressure decreases and water boils at a lower temperature.

The relation between pressure and height and boiling point of water is tabulated in the appendix.

The process of cooking is partly physical but mainly a chemical one. The soaking of rice at room temperature for sometime before cooking appears to be mainly a physical change for the process is reversible, i.e., by drying we get the same stuff again. However, the soaking should not be prolonged too much, otherwise, fermentation may start and the process will be no longer reversible. This preliminary soaking decreases the cooking time to a great etxent.

When rice is fully cooked it swells up to about 2.5 to 3 times its original volume and gives an aroma or flavour characteristic of its variety. For relative comparison of the time required to cook rice at different temperatures one may put up a definite increase in volume as the criterion for proper cooking. Two varieties of rice, (a) the best basmati available in the market, (b) the cheap ration variety were used. The broken bits were removed by passing the rice through a suitable sieve. The graded sample was washed (to remove dust) and dried. The specific heat of these samples averaged between 0.5 to 0.6 calorie per gram per °C. 5 grams of this graded dried sample was put in a wire gauze cylinder and put in a vessel containing water whose boiling point could be controlled by adjusting the pressure. An electrical contact was used to indicate when rice was just cooked as judged by its swelling to three times its original volume. It was found that if the cooking time at 100°C. (sea level) is 10 minutes, at 90°C. it would be 30 minutes and at 80°C. the time required would be two hours. The actual time required at high altitudes would be much greater on account of the environmental conditions of low temperature.

Economy in Cooking.

Rice can be very conveniently cooked in about fifteen minutes if put in a thermosflask containing boiling water. All that is necessary is to bring the water to a boil and pour it in a thermosflask containing rice. In fact the cooking times at different temperatures can be found by using thermosflasks. The actual amount of energy required for cooking except that required to raise its temperature to boiling point, appears to be very small. Below a certain

**Some such difficulties were experienced by the armed forces in Kashmir.

temperature it would not be possible to cook. The chemical action involved in cooking becomes appreciable only at about 80°C. and its optimum value may be at 100°C. Below 80°C. it may be possible to soften the rice by prolonged heating but the flavour will not develop. Cooking in thermosflask will economise labour and avoid any wastage of heat energy.

Height	Pressure in cm. of Hg.	Boiling Point °C.	Cooking Time
Sea level	76	100	10 minutes.
5000 feet	63	95	
10,000 feet	52	90	30 minutes.
15,000 feet	43	85	
20,000 feet	35	80	120 minutes.

By comparing the rates of cooling of boiling water in a three pint thermosflask with and without rice it is found that 100 grams (about 2 chhatanks) of rice required only 1,500 calories of heat in addition to the heat required to raise the rice to the boiling point of water. 100 grams of rice require about 5,000 calories to be raised to boiling point. Two hundred grams of water required for cooking will need 18,000 calories, assuming the initial temperature to be 10°C. and the boiling point of water to be 100°C. Total heat required in kilocalories will be thus :—

For heating water	18
For heating rice	5
For cooking rice	1.5
Total ...	24.5

Thus approximately 25 kilocalories are required to cook about 2 chhatanks of rice. 1 seer of coke gives about 6,000 kilocalories. For 25 kilocalories we shall need 25/6,000 =1/240 seers. = 1/3 tola. If soft coke sells at Rs. 3/-/- per maund the cost of fuel for cooking one meal of rice would be less than 1/16 of a pie. If cooked by electrical energy, costing 3 annas per unit (kilowatt hour) (3,600 kilowatt = 850 kilocalories) the cost of cooking would be about 1 pie.

This indicates that our method of cooking is wasteful and may be termed primitive. Cooking in thermosflask appears to have a good future. A suitable electric element inside a thermosflask may be used to heat the water and bring it to a boil. To this a suitable amount of rice may be added. After about 15 minutes well cooked rice will be ready.

A number of preliminary experiments have been performed to find out how the size, diameter or volume of grams changes with the time for which it is boiled. Grams of various sizes are sorted out. One particular size grams are boiled and their average size after regular intervals of time is determined. It is found that first the size increases rapidly and then very slowly. The cooking starts at a stage when the volume has become practically constant and it appears that relation between diameter or volume and time of cooking is of the exponential form.

Proper cooking of food is a great art acquired empirically by practice. Women are considered to be experts in this art. It is the development of the proper flavour, appearance and palatability of the cooked substance which is important. The nutritive value may not be exactly proportional to these qualities unless psychological factor is given great importance. There is a tendency to ask the question whether it is necessary to cook certain food stuffs such as vegetables. The answer to the question why do we cook vegetables is that we are used to the taste of cooked vegetables. We prefer softer vegetables because we are not used to chew raw vegetables. It is true that softer vegetables are more easily digested. The vitamins, however, are destroyed to a great extent, by the process of cooking.

APPENDIX.

Table showing variation of atmospherical pressure with altitude.

Altitude in feet	Temperature in °C.	Pressure in m. bar	Pressure in cm. of Hg	Boiling point of water °C.
0	15	1013·2	76·0	100
2000	11	942·1	70·7	98·0
4000	7·1	875·1	65·6	96·0
6000	3·1	811·9	60·9	93·9
8000	—0·9	752·5	56·4	91·8
10000	—4·8	696·9	52·3	89·9
12000	—8·8	644·3	48·3	87·8
14000	—12·7	595·1	44·6	85·7
16000	—16·7	549·0	41·2	83·7
18000	—20·7	505·7	37·9	81·6
20000	—24·6	465·3	34·9	79·6