PROCESSING OF HARD COOKING PULSES, PEAS AND BEANS, STUDIES ON THE METHODS OF THEIR SOAKING AND COOKING.

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ABSTRACT

Quick methods of soaking and cooking the common hard cooking pulses i.e. Phaseolus mungo Linn (*urad*), Cicer arietinum Linn (*Chana*), Cajanus indicus Spreng (*Arhar*), Pheseolus aurous Roxb (*Moong*), Lens esculenta Moench (*Masoor*), Pisum Sativum Linn (*Peas*), and Phaseolus lunatus Linn (*Rajmah*), have been evolved. The effects of these procedures on the palatability of the cooked samples are reported.

The various pulses, peas and beans on storage for a few years or when hard water is used do not cook so readily. This change in the property, is responsible for a greater consumption of the fuel, wastage of time, and extra labour.

Dawson, Lamb, Toepfer, and Warren[1] have studied a few methods of soaking and cooking various dry beans e.g. pea, great northern, large lima, pinto and red kidney. For pea beans the effect of its storage at 40° and 75°F for 1 year, on cooking time is reported. Nutritive value determinations were made for pea beans, including thiamine and ash contents after soaking and cooking in different ways. Bitting[2], Gloyer[3], Morris, Olson, Bean[4] and Snyder[5] have recommended for preparing hard shell beans some kind of heat treatment prior to soaking.

Mattson[6] found that the important factor in the cookability of peas was the high content of phytin, which is a calcium and magnesium precipitant. The precipitating power of phytin is greatly increased at boiling temperatures. At the pH of peas (about 6) phytin can function as a magnesium precipitant only at boiling temperature.

Subba Rao and Subrahmanyan[7] have observed that the presence of small amounts of salts of heavy metals and alkaline earth metals retard the cooking of pulses to a considerable extent. In substrates which are either mildly alkaline or which contain substances precipitating Ca, Mg and heavy metal salts the cooking was accelerated.

Greenwood[8] and Synder[5] found the use of baking soda in either the soaking or cooking water to be an effective means of softening the seed coats of pinto, great northern, or navy blue. Reeve[9] studied the tenderization of peas by sodium sulphite, oxalic acid, ammonium oxalate and hydrochloric acid.

Boiling is the common method used for cooking these articles. A typical procedure includes soaking overnight at room temperature in several volumes of water and cooking until tender in the soaking water or in fresh water with salt, spices and fat. This procedure is time consuming especially when hard pulses are to be cooked or when hard water is used.

This study was undertaken to develop more rapid basic methods of cooking hard pulses that would save time, conserve nutritive values and yield products of high acceptability. Varieties of pulses studied were Phaseolus mungo Linn, (urad), Cicer arietinum Linn, (chana), Cajanus indicus spreng, (arhar), Phaseolus aureus Roxb, (moong), Lens esculenta Moench, (masoor), (all stored for two years in tins at about 30°C), together with Pisum Sativum Linn (peas), Phaseolus and lunatus (rajmah). The effect of different soaking and cooking conditions on the rate of water absorption, cooking time and palatability was investigated for all of these samples and the results compared with that of fresh ones.

The results show that a short method of soaking in which these pulses are added to boiling water, boiled 2 minutes, removed from the heat, and allowed to soak for 1 hour in hot water gives satisfactory results. When soaked by this method and cooked in the liquid used for soaking, all the varieties of pulses studied were comparable or superior in palatability to those prepared by the usual procedure of soaking overnight or at least 4 to 5 hours and discarding the soaking liquid. When the pulses are subjected to this process they take about 20 per cent less time than those unsoaked and cooked as such.

In general, the alkalies are quite effective in reducing the cooking time. The less ionised alkalies like NH_4OH penetrate more readily into the cells of the pulses than $NaHCO_3$. The addition of 5% NH_4OH to the cold pulse, just after its 1 hour hot-soak, lowers the cooking time to approximately that with the pressure cooker (15 pounds pressure). The use of 0·5 gm of $NaHCO_3$ to 200 gm dry pulse and 800 c.c. (approx. 4 times) of water, during cooking reduced the cooking time to 40% (approx.) and resulted in a good quality product. Here the taste was a bit saline and the colour slightly brownish. The cooking time was considerably redueed by cooking pulses in a pressure cooker.

Soaking of pulses under different Conditions

An exploratory study was carried out to find the effect of storage on the water absorption of the pulses under various conditions. 10 gm of the pulse was soaked in distilled water (W/V 1 : 4) for ½, 1, 2, 3, 4, 5, 6, and 18 hours, water was drained off, the pulse was dried by pressing it in between the filter papers, and weighed. Table I gives the ratio of wt. of the soaked pulse to wt. of the dry pulse for new and old samples studied at 25°C at different intervals of time.

The water imbibition in old pulses is less than the new ones; this is probably due to the denaturation of proteins of the cells in the pulses.

For the sake of studying the water absorption at different temperatures 10 gm of the pulse were taken in different wire gauze cylinders, which were dipped in distilled water (2 litres) kept in a 4 liter beaker. The latter was kept

TABLE I

Time Hrs	Moong		Arhar		Masoor		Chana		Urad	
	New	Old	New	Old	New	Old	New	Old	New	Old
0·0	1·00	1·00	1·00	1·00	1·00	1·00	1·00	1·00	1·00	1·00
0·5	1·648	1·593	1·541	1·460	1·473	1·435	1·481	1·406	1·830	1·718
1·0	1·856	1·782	1·744	1·654	1·635	1·541	1·572	1·515	1·925	1·811
2·0	1·956	1·823	1·962	1·646	1·695	1·622	1·734	1·641	1·960	1·809
3·0	1·972	1·806	1·995	1·906	1·734	1·652	1·778	1·661	1·947	1·818
4·0	1·973	1·805	1·981	1·902	1·738	1·664	1·803	1·664	1·950	1·809
5·0	1·984	1·788	1·954	1·898	1·745	1·663	1·810	1·684	1·934	1·818
6·0	1·976	1·780	1·956	1·898	1·734	1·661	1·803	1·654	1·936	1·813
18·0	1·918	1·698	1·967	1·899	1·714	1·592	1·767	1·651	1·782	1·761

covered with a dish and only opened at the time of weighings. In the case of peas the temperatures of soaking included (*a*) 100°C (212°F) for 2 minutes decreasing to room temperature 21°C., (*b*) 50°C (122°F) constant temperature, (*c*) 50°C(122F) initial temperature decreasing to room temperature 21°C, and (*d*) room temperature, 21-22°C constant. Figure I shows the comparative rate of water absorption by peas in distilled water as affected by temperature and time of soaking.

The time required for water absorption to a constant ratio depended on the temperature of the soaking water. The ratio of the soaked to dry peas reached an average of 1·78 to 1·83 in 1 hour when the peas were boiled for 2 minutes and allowed to cool at room temperature, in 2 hours by holding at 50°, in 3 hours by starting at 50° and cooling at room temperature, and in about 7 hrs. by holding at room temp (21—22°C). The amount of water absorbed by the peas after 18 hours soaking in the cases of (*c*) and (*d*) is a bit higher than in those of (*a*) and (*b*). Phascolus radiatus (old) on hot-soaking (100°C for 2 minutes) attains a ratio of about 1·96 just after half an hour, a value never reached by the new and old samples by soaking at room temperature.

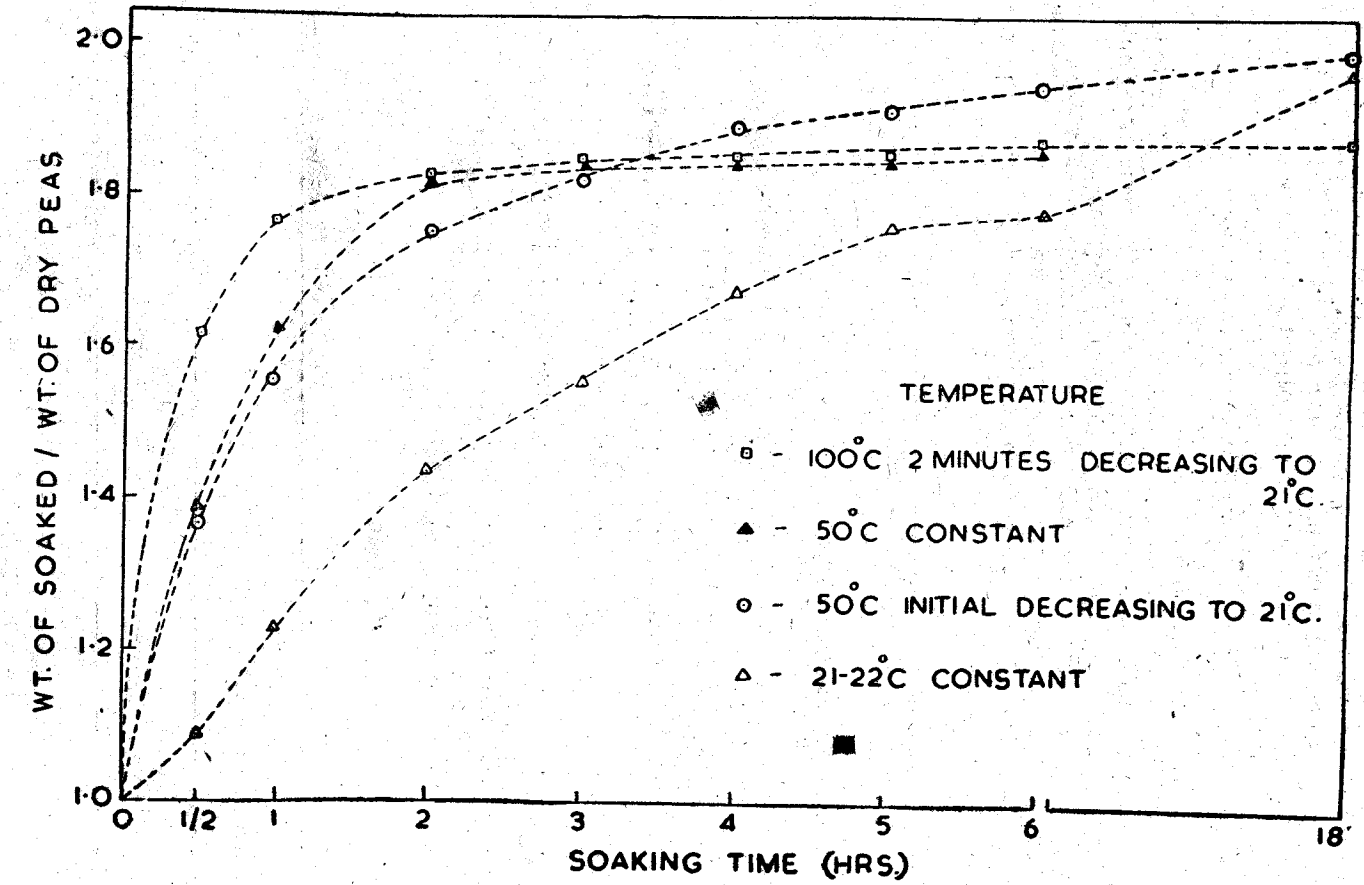
WT. OF SOAKED / WT. OF DRY PEAS
2·0
1·8
1·6
1·4
1·2
1·0
0
1/2
1
2
3
4
5
6
18
SOAKING TIME (HRS.)
TEMPERATURE
100°C 2 MINUTES DECREASING TO 21°C.
50°C CONSTANT
50°C INITIAL DECREASING TO 21°C.
21-22°C CONSTANT

Figure 1

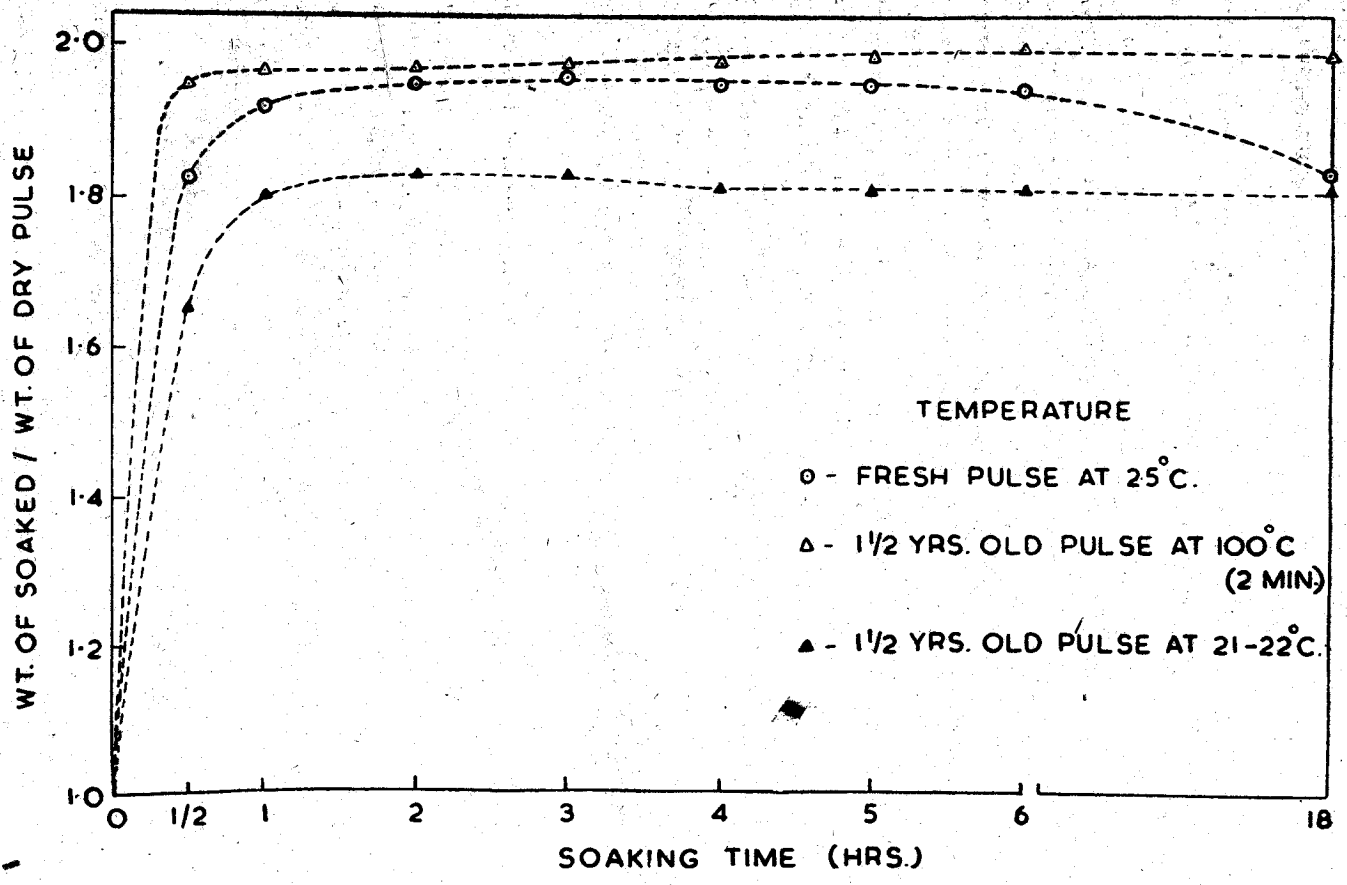
WT. OF SOAKED / WT. OF DRY PULSE
2·0
1·8
1·6
1·4
1·2
1·0
0
1/2
1
2
3
4
5
6
18
SOAKING TIME (HRS.)
TEMPERATURE
o - FRESH PULSE AT 25°C.
Δ - 1½ YRS. OLD PULSE AT 100°C (2 MIN.)
▲ - 1½ YRS. OLD PULSE AT 21-22°C.

Figure 2

Figure 2 gives the ratios of soaked/unsoaked fresh and old Phaseolus radiatus affected by temperature and time of soaking in distilled water.

Cooking in a Covered Beaker

The cooking experiments were done in a pyrex beaker (250 c.c.), that was kept three fourth covered with a watch glass. The ratio of dry pulse to water in every case was 1 : 4. 6 percent of NaCl (on the weight of the dry pulse) was added while cooking. In the experiments where a pulse was subjected to 1 hour hot-soak, the soaking liquid was retained and used as the water for cooking. In the case of rajmah and peas, softness and non-pasty consistency; while for all other pulses semi-pasty forms were the criteria of the cooked samples. Table II gives the cooking times of various samples, studied under different conditions.

Cooking in a Pressure Cooker

For soaking and cooking the pulses, water of three types was used: (A) Distilled water, (B) synthetic hard water—distilled water containng $CaSO_4$ in amounts calculated as 250 p.p.m. $CaCO_3$, and (C) synthetic hard water with the addition of 0·5 gm of $NaHCO_3$ to 623 c.c. of water (0·08 % solution). Hardness of 250 p.p.m. was selected because most of the hard water in India has approximately this concentration of the salt.

For all these experiments the pulses were soaked in the cold for 1 hour before cooking. The soaking was done in the corresponding water (ratio pulse to water 1 : 4), and the same liquid used for cooking. This amount of water gives the right type of semi-pasty cooked product. The samples were cooked at 250°F (15 pounds steam pressure). The time for heating up the pressure cooker when the steam generated was 9 minutes, and the period from the time of steam generation to the time of the development of 15 pounds pressure 3 minutes. Cooking time was counted from the time a temperature of 250°F was reached. Table III gives the cooking time in minutes of different pulses using various es of water.

The tastes of the cooked pulses were practically the same as in the case of cooking in a covered beaker.

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TABLE II

Type of pulse	FRESH PULSES (Cooking-Time in minutes) (No pre-soaking)	OLD PULSES (Cooking time in minutes) (No pre-soaking)	5% CH_3COOH (No pre-soaking)	8% NH_4Cl (No pre-soaking)	8% NH_4NO_3 (No pre-soaking)	2% Sodium hexametaphosphate (No pre-soaking)	0·5 gm $NaHCO_3$ per 200 gm pulse (No pre-soaking)	After 1 hr. hot-soak Initial Temp 100°C (2 min)	5% $(NH_4)_2CO_3$ added during soaking below 70°C (Hot soaking 1 Hr)	1 Hr Hot-Soak then 5% NH_4OH.
Rajmah (Red beans) ..	95—105	..	110—115	92—95	85—90	80—82	52—55	70—75	20—25	10
Peas	90—100	..	95—100	90—95	80—85	70—75	40—45	60—65	18—20	8
Urad dal (dehusked) ..	75—80	95—100	95—105	95—97	85—90	70—75	50—54	65—70	15—18	8
Chana (dehusked) ..	70—75	80—85	75—80	70—80	70—75	65—70	40—44	60—65	15—20	8
Arhar (dehusked) ..	35—45	50—55	45—50	50—52	40—45	40—42	30—35	40—45	12—14	10
Moong (dehusked) ..	30—40	42—46	35—40	44—46	35—38	30—35	25—28	30—35	10—12	6
Masoor (dehusked) ..	20—30	35—38	30—32	32—36	28—30	25—28	18—20	25—30	8—10	4

TABLE III

Types of Pulse	NEW PULSES			OLD PULSES		
	A—Water	B—Water	C—Water	A—Water	B—Water	C—Water
Rajmah (Red beans)	9	..	..	..	..	..
Peas	7	..	..	..	..	..
Urad (dehusked) ..	12	18	14	15	30	18
Chana (dehusked) ..	12	20	15	17	28	18
Arhar (dehusked) ..	4	7	5	8	14	10
Moong (dehusked) ..	3	5	3	4	8	4
Masoor (dehusked) ..	2·5	3·5	2·5	3	5	3

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