# MANUFACTURE OF TABLE SALT FROM INDIGENOUS ROCK SALTS

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Good quality table salts are almost all imported. The local brands do not conform to specifications in chemical and free-running properties. The authors have investigated the feasibility of preparing free-flowing table salts from indigenous rock salts by simple crystallization and coating the crystals with 1% of calcium or magnesium carbonate. The chemical compositions of the raw materials and the prepared table salt, along with those of local and foreign brands have been determined. The grain sizes of different varieties have also been compared.

Edible salt is mostly consumed in Pakistan in the form of crushed rock salt or evaporated sea salt without further purification. These salts vary in their purities. The purer varieties of rock salts satisfy the chemical requirements of standard specifications but others require some purification.

The demand for so called 'free-flowing table salt' is also increasing in the country. Several brands of indigenous table salts are being sold in the market at an average price of Rs. 0.62 to 0.87 per lb. but most of them form lumps and do not flow freely from the holes of salt bottles. There are a few brands of imported salts which sell at Re. 1 to Rs. 2.50 per lb. These are quite excellent in their general appearance and free-flowing properties.

The object of the present investigation has been to examine critically the conformity of Pakistani and foreign brands of table salt to the standard specifications and the possibility of preparing first quality table salts from the crude salts by simple crystallization.

*Chemical Composition.*—Imported and Pakistani table salts, and Pakistani rock salts were collected from the local market (Peshawar). All the samples have been fully analyzed including the trace elements by standard methods. Results are shown in Table 1. On the basis of the major constituents, the probable compositions have been calculated[4] and shown in Table 2.

*Grain Size and Flowing Property.*—One of the important criteria for table salts is their free-flowing property. On actual tests in salt bottle, the foreign brands flowed quite freely but the indigenous ones clogged the holes of the bottl · The samples were subjected to sieve analysis[7] and the results are shown in Table 3.

*Conformity of the Samples to Standard Specifications.*—The imported varieties of table salts conform to standard specifications U.S. Federal Specifications No. SS-S—31d[1] and South African specification for super grade industrial salt[2] in respect of their chemical composition and grain size (sieve tests) except the added drying matter, i.e., basic magnesium carbonate (1.21% and 1.16% res-

TABLE 1.

| | Imported table salt % | Pakistani table salt % | Pakistani rock salt of Jutta, Ismail Khel % |
|---|---|---|---|
| Moisture | 0.015 | 0.035 | — |
| Insoluble matter | — | 0.067 | 0.157 |
| Chloride (as $Cl'$) | 59.62 | 59.50 | 59.90 |
| Carbonate (as $CO_3''$) | 0.84 | — | — |
| Sulphate (as $SO_4''$) | — | 0.627 | 0.497 |
| Calcium (as $Ca^{++}$) | — | 0.107 | 0.057 |
| Magnesium (as $Mg^{++}$) | 0.318 | 0.078 | 0.056 |
| Arsenic (as $As^{+++}$) (Gutziet method[3]) | — | — | — |
| Copper (as $Cu^{++}$) (by dithiozone extraction[3]) | 3.8 p.p.m. | 2.1 p.p.m. | 6.3 p.p.m. |
| Lead (as $Pb^{++}$) (by dithiozone extraction[3]) | — | 1 p.p.m. | 2 p.p.m. |
| Iron as ($Fe^{+++}$) (by colour by thiocyanate). | 3.5 p.p.m. | 59 p.p.m. | 39 p.p.m. |
| Fluorine (as F) (by Magregian-Maier method[3]) | < 15 p.p.m. | < 5 p.p.m. | < 5 p.p.m. |

pectively, calculated from their magnesium contents), which are somewhat higher than the maximum allowable 1.0%.

The Pakistani brand of table salt conformed to the chemical requirements except the iron content which is higher than the allowable maximum of 20 p.p.m. As regards their grain size, they all formed lumps but passed the sieve tests when the lumps were broken, but even then they did not acquire the free-flowing characteristics.

All the samples of crude rock salts failed to satisfy the required chemical composition in respect of insoluble matter, calcium sulphate, iron and copper. The minimum contents of sodium chlorides are also lower.

No sieve tests have been performed on the crushed rock salts.

*Preparation of Free-Flowing Table Salt in the Laboratory.*—A saturated solution was prepared by dissolving 450 g. of rock salt in water and about 350 g. were crystallized out from the liquor by simple evaporation on heating over burners.

The crystals were filtered in Buchner funnels and dried in oven, and then sieved through

TABLE 2

| | Imported table salt % | Pakistani table salt % | Pakistani rock salt of Jutta, Ismail Khel % |
|---|---|---|---|
| Moisture | 0.015 | 0.035 | — |
| Insoluble matter | — | 0.067 | 0.158 |
| NaCl | 89.855 | 98.375 | 98.700 |
| $CaSO_4$ | — | 0.364 | 0.195 |
| $CaCO_3$ | — | — | — |
| $MgCO_3$ | 01.158 | — | — |
| $MgSO_4$ | — | 0.267 | 0.278 |
| $Fe_2O_3$ | — | Trace | Trace |
| $Na_2SO_4$ | — | 0.289 | 0.170 |
| Total .. | 100.033 | 99.378 | 99.502 |

TABLE 3.—SIEVE ANALYSIS OF TABLE SALTS.

| I. M. M. Mesh No. | | 10 | 20 | 30 | 40 | 60 | 80 | 90 | 100 | 120 | 120 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approx. U.S. Mesh No. | | 16 | 30 | — | — | 70 | — | — | 80 | — | — | |
| Opening in inches | | 0.05 | 0.025 | 0.0166 | 0.0125 | 0.0083 | 0.0062 | 0.0055 | 0.005 | 0.0042 | | 100 |
| Opening in microns | | 1270 | 635 | 421.64 | 317.5 | 211.85 | 157 | 138.21 | 127.00 | 107.91 | | |
| Average size of the particles in microns | | — | 952.5 | 524.32 | 370.57 | 264.18 | 185.31 | 149.98 | 134.1 | 116.4 | | |
| Wt. P. R. | Imported table salt | 0.0 | — | 0.08 | 17.42 | 19.25 | 36.64 | 11.84 | 4.35 | 5.37 | 5.05 | 100 |
| C. P. O. | | 0.0 | — | 0.08 | 17.50 | 36.75 | 79.39 | 85.23 | 89.58 | 94.95 | 100.0 | |
| C. P. U. | | 100.0 | — | 99.92 | 82.50 | 63.75 | 26.61 | 14.77 | 10.42 | 5.05 | | |
| Wt. P. R. | Pakistani table salt | 0.0 | 2.3 | 18.5 | 42.1 | 8.6 | 10.8 | 6.6 | 1.3 | 2.8 | 7.00 | 100 |
| C. P. O. | | 0.0 | 2.3 | 20.8 | 62.9 | 71.5 | 82.3 | 88.9 | 90.2 | 93.0 | 100 | |
| C. P. U. | | 100 | 97.7 | 72.2 | 37.1 | 28.5 | 17.7 | 11.1 | 9.8 | 7 | — | |
| Wr. P. R. | Prepared sample | 0.0 | 0.0 | 0.0 | 45.90 | 20.20 | 13.85 | 12.85 | 4.45 | 1.87 | 0.87 | 100 |
| C. P. O. | | 0.0 | 0.0 | 0.0 | 45.90 | 66.1 | 79.90 | 92.85 | 97.20 | 99.07 | 100.00 | — |
| C. P. U. | | 100.0 | 100.0 | 100.0 | 54.10 | 33.9 | 20.10 | 7.15 | 2.80 | 00.93 | | |

Wt. P. R. = Weight per cent retained. C. P. O. = Cumulative per cent oversize. C. P. U. = Cumulative per cent undersize.

I.M.M. sieve No. 100. About 20% undersize passed through. The undersize portion can be utilized again by re-dissolving in the mother liquor or can be utilized in medicine as it satisfied B.P. Standard for sodium chloride.[5] The samples were then sieved through I.M.M mesh No. 30 for oversize particles. Practically none were retained. The proper-sized crystals were then given a coating of light magnesium carbonate (1 per cent by weight) by mixing. In physical appearance the prepared table salt looked similar to the imported ones. It flowed quite freely through salt bottle after several months of storage. The sample did not form lumps even when it was kept exposed to the atmosphere.

In grain size and sieve tests as shown in Table 3 under sample designated as "Prepared sample", it passed the prescribed limit tests as set out in U.S. Federal specifications.

The chemical composition of the sample, as carried out before the addition of drier passed all specifications and is given as follows:—Moisture, trace; insoluble matter, nil; carbonate (as $CO_3''$), nil; Sulphate (as $SO_4''$), 0.107%; calcium (as $Ca++$), 0.022%; magnesium (as $Mg++$), 0.009 %; arsenic (as $As++$), nil; copper (as $Cu++$), 0.99 p.p.m.; lead (as $Pb++$), nil; iron (as $Fe+++$), 7 p.p.m.; fluorine as F), less than 5 p.p.m.

The probable composition of the salt has been calculated as follows:—Miosture, trace; calcium sulphate, 0.075%; magnesium sulphate, 0.05%; sodium sulphate, 0.02%; sodium chloride, 99.85%.

## References

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