

## The Control of Iodine Deficiency Disorders by Supplying Hubei Iodinated Refined Salt

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### ABSTRACT

In order to control Iodinated Deficiency Disorders (IDD) by supplying iodinated refined salt, Hubei province has been producing iodinated salt since 1964. Hubei Anti-Epidemic Station and Hubei Salt Company has been conducting many investigations. Using concentric iodination technology at the production sites, our province has obtained significant results by supplying popularly iodinated salt on a large scale in IDD areas of the entire province. The morbidity rate from endemic goiters has decreased from 25.36% before 1964 to 1.65% in 1990. Hubei Iodinated Refined Salt contains 98.5-99.3% NaCl, 15-30 ppm iodine. Hubei Province is the first province among the 14 provinces, municipalities and autonomous regions of south China to reach the National Standard for IDD control in 1985. These observations prove that applying concentric iodination technology to well-rock salt production sites is successful at a low cost — only about US \$0.01 per capita per year. Meanwhile, twenty other provinces, municipalities and autonomous regions such as Guizhou and Jilin, considered to be IDD areas of China, have benefited from using Hubei Iodinated Refined Salt. Recently, it has also been sold to the world to make a new contribution to controlling IDD.

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### INTRODUCTION

Hubei has a population of 52 million and is located in the middle reaches of the Yangtze River with a total area of over 180,000 km<sup>2</sup>. The provincial capital is Wuhan. Hubei province is an inland salt base which has developed since the founding of New China. The principal product, iodinated refined salt, has been making a significant contribution toward prevention and cure of endemic goiters. Hubei province is the first province among the 14 provinces, municipalities and autonomous regions of South China, to reach the National Standard for IDD control. Meanwhile, 20 provinces, municipalities and autonomous regions such as Guizhou and Jilin — IDD areas of China — have benefited from Hubei Iodinated Refined Salt. Recently, it has also been sold to the world market to make a new contribution to controlling IDD.

This paper briefly discusses iodination technology and economy, the success of Hubei Iodinated Refined Salt and the actual effect of the control of IDD during some twenty years.

### IODINATION TECHNOLOGY OF HUBEI IODINATED REFINED SALT

Hubei Iodinated Refined Salt is refined from our provincial rock salt which is in great supply and has a high degree of purity. It is produced by an advanced vacuum salt-making technique. Salt iodination technology depends on advanced solution mining by which rock salt is turned into brine at more than 22°Bé and brought to the surface. The brine is then clarified and filtered and flowed through pipelines, preheated to 80-110°C by heat exchangers and evaporated in multiple-effect vacuum pans.

The slurry from the previous process is then transferred to centrifuges where the remaining brine is removed. It then goes to a fluid bed dryer from which it emerges completely dry to await attracting rust, screening and weighing as well as packing. In a highly mechanized and automated production line, the iodinated procedure is formed by acquiring iodination equipment before the fluid bed dryer (see Fig. 1).

The iodination technology is described below.

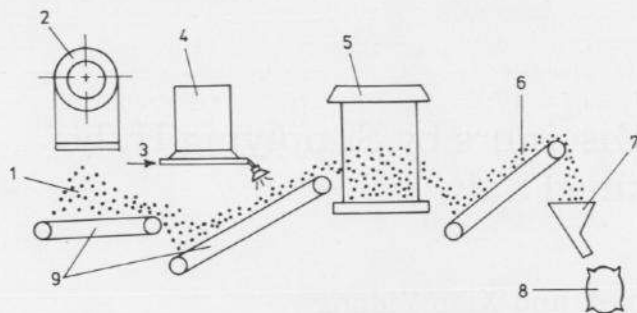


Fig. 1. Diagram of the process of salt iodination at production sites. 1. Salt. 2. Centrifuge. 3. Vapour. 4. Vessel of iodine solution. 5. Fluid bed dryer. 6. Iodinated salt. 7. Hopper of salt. 8. Bagged salt. 9. Conveyor belt. (Chu, 1979).

First, according to the standard stipulated by the local public health department, an iodine compound solution with a stabilizer is prepared by heating and stirring fully; the well-dissolved solution is stored in a special purpose vessel. The iodine compound used in Hubei now is potassium iodate ( $KIO_3$ ), the proportion of iodine compound to salt is stipulated at 1:30000 by the standard of the health department in Hubei province. The amount of iodine compound is calculated according to the same shift salt output and the stipulated formula in the standard. Potassium iodate is put into a special vessel, then pure water is added to 4% concentration solution. There is a steam pipe and a slow speed stirrer in the vessel. The potassium iodate can be dissolved in water at  $80^\circ C$  in approximately 20 min. Next, the preparation of iodine solution is carried into a stainless steel vessel. When salt containing less than 3% moisture is transferred from centrifuges to a belt conveyer, the automatic instrument above the iodine solution vessel receives a signal and sprays the precise amount of the solution through nozzles onto the salt. Afterwards, salt containing iodine is conveyed by conveyer belt into a fluid bed dryer, in which salt is fluidised and rolled from top to bottom at high temperature under negative pressure for 5 min or so as if boiling water rapidly in a pan. The moisture of salt from the dryer is only less than 0.1%, meanwhile, potassium iodate is uniformly mixed with salt in the dryer; this makes iodinated salt qualified. Finally, the qualified iodinated salt goes through the attracting rust electromagnet, weighing and packing. It then enters the warehouse and awaits shipment. Workshops are bright and spacious, with a quiet atmosphere and are smartly laid out. The quality supervision system for Hubei Iodinated Salt is excellent. Every level conducts quantitative analysis. There are two level laboratories in the plant. The workshop laboratory makes a quantitative analysis

once every two hours. This guides production. The plant's central laboratory is responsible for supervising the quality of products every day. In addition, the Hubei Provincial Quality Supervision and Test Centre Station is in charge of selective examinations every five days. In marketing areas, the Department of Public Health laboratories are responsible for monitoring the iodine content of the salt in warehouses, stores and households. At all levels, the laboratories have excellent instruments, well trained technicians and good environments.

For many years, according to laboratory test reports, Hubei Iodinated Refined Salt has contained 98.5–99.3% NaCl, has an iodine content 15–30 ppm and shades of white more than  $80^\circ$ . The grain size of the salt is mainly  $294 \mu m$ , it is loose and running, and is an excellent edible salt.

#### ECONOMY OF SALT IODINATION AT PRODUCTION SITES

At present, iodination of refined salt is mainly divided into: iodination at production sites, and iodination in marketing areas. Hubei Iodinated Refined Salt belongs to the former.

The expenses of iodination include the cost of the iodine itself, processing costs, administrative overheads, packing material and fixed asset depreciation (Manner, 1988).

For convenience of comparison, excluding the cost of packing materials, we make comparison among the other items.

Processing costs include salary and extra charges, plant maintenance and spare parts, power and laboratory test. Generally, administrative overheads are estimated at one-third of processing costs. The fixed asset depreciation refers to building and equipment. Under normal service conditions the life of equipment could be rated conservatively at ten years and the life of the building at 20 years.

Because iodination in marketing areas is an independent system, even processing in the salt warehouse still requires considerable new space, purchasing a complete set of processing equipment and the recruitment of workers needed for this purpose. However, iodination in automatic lines at production sites only requires the augmentation of a few workers and the purchase of iodination equipment, therefore there is quite a difference in cost between the two. Table 1 gives iodination costs collected from home and abroad (Dunn and van der Haar, 1990).

It can be seen from Table 1 that the cost of iodination at production sites in Hubei is the lowest, equal to 16.5–40% of the costs of iodination in marketing areas.

TABLE 1

Comparison of iodination costs (unit: US\$/t)

No.	Item	Iodination technique in marketing areas in China	Iodination technique at production sites in Hubei	Iodination technique in marketing areas abroad
1	Iodine cost	0.9	0.9	0.75-2.0
2	Processing cost	1.4-5	0.15-0.2	2.35-5.5
3	Administrative overheads	0.3-1.6	0.05-0.1	0.60-1.5
4	Depreciation	0.4-1.0	0.1-0.2	0.5-2.50
5	Total	3.0-8.5	1.2-1.4	4.2-11.5

TABLE 2

Quality and iodine content of Hubei Iodinated Refined Salt, 1983-1990

	1983	1984	1985	1986	1987	1988	1989	1990
Certified % of iodinated salt	93.70	96.12	94.17	93.20	93.27	96.66	96.88	95.9
Average iodine content (ppm)	21.60	22.60	16.27	25.35	25.57	21.36	29.97	15.23

TABLE 3

Goiter morbidity rates before and after 1964-1965

	Surveyed population	Number of patients	Goiter rate of monitored areas	Goiter rate of whole province
Before 1964-65	1,115,950	283,045	25.36%	25.36%
1983	40,335	2,973	7.37%	7.37%
1984	42,237	2,694	6.38%	6.38%
1985	116,258	3,326	2.86%	2.86%
1986	112,563	2,735	2.43%	2.43%
1987	140,160	3,038	2.17%	2.17%
1988	179,510	3,230	1.80%	2.02%
1989	171,408	2,741	1.60%	1.80%
1990	38,782	516	1.33%	1.65%

As far as we know, the costs of iodination in marketing areas abroad are in the range of US\$ 4.2-11.5 per ton. Compared with this, the costs of the concentric iodination in Hubei is far less than the cost of iodination in marketing areas abroad, equal to 12-29% of the cost.

The costs of iodination in foreign countries increased to US\$ 0.0042-0.0115 per kg; the costs in Hubei increased to US\$ 0.0012-0.0014. Assuming per capita salt consumption is 7 kg per year in Hubei and 5 kg per year abroad, this represents the extra cost per capita in China increasing to US\$ 0.008-0.01, and the extra cost per capita abroad increasing to US\$ 0.02-0.06.

The costs of iodination of Hubei refined salt are the lowest because of the superiority of modern tech-

niques being used. The product is processed once at production sites, which avoids the possibility of contamination by processing again in marketing areas.

#### EFFECT OF THE PREVENTION AND CURE OF IDD

Hubei Iodinated Refined Salt has been produced and supplied since 1964. Technique and management have been improving and Hubei Province has had an effect in the prevention and cure of iodine deficiency disorders. Table 2 indicates the quality of Hubei Iodinated Refined Salt.

Based on data from the Department of Public Health, goiter morbidity rates before and after 1964-1965 are given in Table 3.

TABLE 4  
Goiter morbidity rates of Maoping township, Nanzhang County

	Year	Surveyed population	Number of patients	Goiter rate %
Before supplying iodinated salt	1964	1,354	950	70.16
After supplying iodinated salt	1980	39,663	2,012	5.07
After supplying iodinated salt	1985	2,465	96	3.89

Nanzhang county is the trial area of IDD in Hubei Province. The goiter rate of Maoping township, Nanzhang county is shown in Table 4.

### CONCLUSIONS

It can be seen from the above tables that Hubei Iodinated Refined Salt is an effective measure of comprehensive prevention and cure of IDD. Hubei Iodinated Refined Salt is not only sufficient for Hubei Province, but is also a source of supply to 20 other provinces. For example, Hubei Iodinated Refined Salt makes up 35% of the total iodinated salt in Guizhou Province. Guizhou was a serious IDD area. Its 95% IDD areas are up to the standard of basic control of IDD in 1985. Guangxi, Heilongjiang and

Jilin have benefited from Hubei Iodinated Refined Salt. Recently, it has also been sold on the world market to Southeast Asia and in regions of the Middle East for the control of IDD.

The successful edible salt iodination technique, along with successful prevention and cure of IDD at low cost, has gained high esteem for Hubei Iodinated Refined Salt. The capacity of Hubei refined salt is 1.40 million t per year. The capacity of iodinated refined salt is 1.2 million t per year; actual iodinated salt production is more than 600,000 t per year. We are willing to serve wholeheartedly to control IDD in China and the world with Hubei Iodinated Refined Salt and the iodination technique.

### ACKNOWLEDGEMENT

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