

JMCSACCHARIN

Beyond Sweetness

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The World's Best and Global Leader JMC Saccharin



Since 1953, **JMC** has been recognized as the best quality Saccharin producer in the world. JMC has used 65 years of accumulated technological expertise and a skilled workforce to become today's global market leader.

JMC Saccharin is the world's highest quality Saccharin available today.

Using the traditional Remsen & Fahlberg Process, JMC is the only company that produces all the high purity raw-materials, including the OTSA, from its own production lines. This in-house, vertically-integrated production ensures the highest purity products which leads to the highest quality Saccharin.

The perfect harmony between tradition and technology:
this is JMC Saccharin.

Did you know that **Saccharin** has been a part of our daily lives for more than **100** years?

Discovered by I. Remsen and C. Falberg in 1879, Saccharin, as an artificial sweetener and a substitute for sugar, has long been a part of our lives. We use Saccharin in our coffee/tea, in our cereal and eat it in many reduced-calorie or sugar-free foods and beverages every day. **Saccharin** is 350 to 500 times sweeter than sugar, yet has zero calories. In addition, it leaves the body after consumption without being absorbed. Saccharin is very effective against obesity, diabetes and thus supportive of health. The safety of Saccharin has been a long controversy, but years of numerous tests and experiments have proven irrefutably that such prejudice has been unfounded. Authorities such as WHO, NTP and the FDA have also repeatedly confirmed its safety. Saccharin, with over a century of use, has long been prepared for a 'Sweet Future' in which it will only grow in popularity.

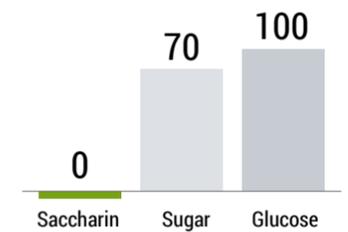


Saccharin is **Healthy**

Saccharin, unlike sugar, has no effect on blood sugar levels and has zero calories. It is therefore considered as an important sugar substitute to help combat diabetes and obesity. Furthermore, while it is well-known that sugar produces cavities, Saccharin does not produce any of the acid that results in cavities.

The benefits of Saccharin, which aids diet, diabetes control and cavity prevention, can be realized without giving up the happiness derived from its sweetness.

Diabetic patients can safely consume Saccharin because its Glycemic Index (GI) is **zero**.



Obesity is not a concern because it also has **zero** calories.



Saccharin is Excellent

Saccharin is 350 to 500 times sweeter than sugar and costs only 1/40 the price of sugar and 1/8 the price of aspartame for the same level of sweetness. It can be called 'The Dream Sweetener' in terms of sweetness and economical feasibility as well as health. The sweetness equivalency costs are below.

\$1.00/kg Saccharin will provide as much sweetness as:



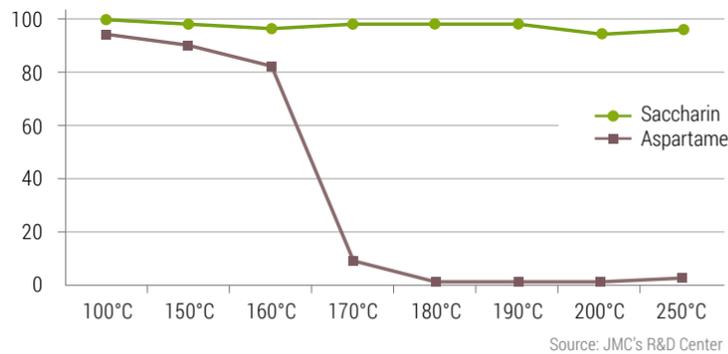
Based on the Korean domestic market prices in 2016

Saccharin's strength is not only limited to its economic value. It can also be preserved for a long period of time without decomposition and can act as an effective stabilizer.

Moreover, this 'Dream Sweetener' is heat stable. Under conditions of increasing heat, Saccharin remained stable at temperatures up to at least 250°C. By comparison, aspartame started to decompose at 150°C and was completely decomposed at 180°C.

These results demonstrate that aspartame is not appropriate as a sweetener for high temperature usage in food such as baked goods.

Thermal Resistance Comparison Between Saccharin and Aspartame



Decomposition Rate According to Temperature

| Temperature | 100°C | 150°C | 160°C | 170°C | 180°C | 190°C | 200°C | 250°C |
|-------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Saccharin | 99% | 98% | 97% | 98% | 98% | 98% | 95% | 96% |
| Aspartame | 95% | 91% | 82% | 9% | 1% | 1% | 1% | 2% |

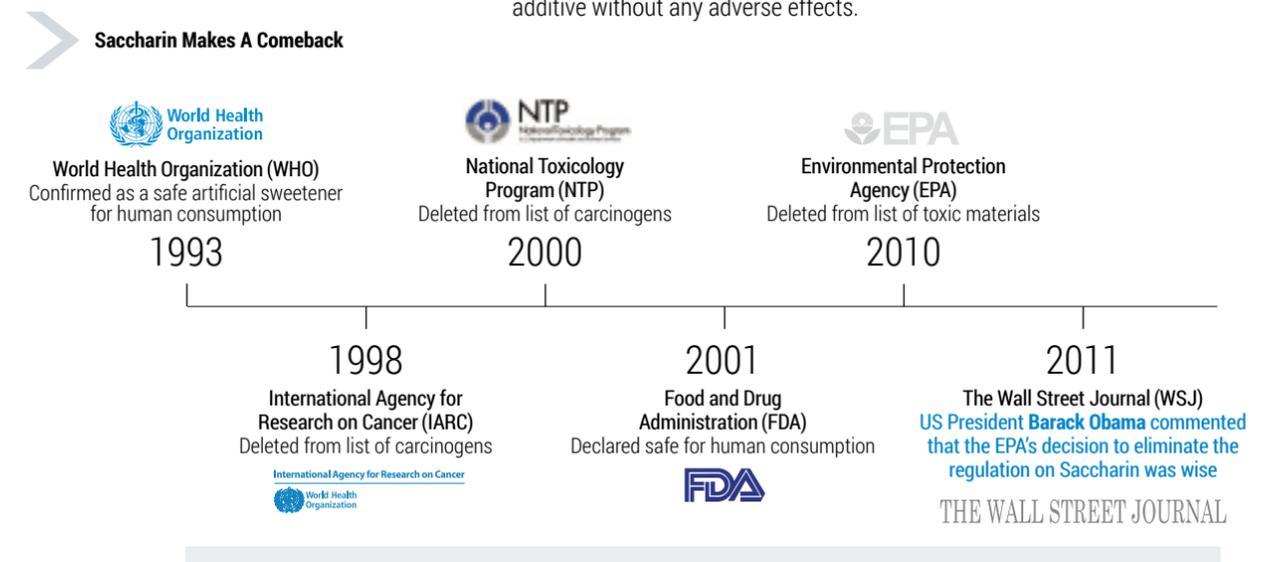
Source: JMC's R&D Center



Saccharin is Safe

Saccharin is the oldest artificial sweetener in the market today, having been discovered in 1879. However, Saccharin faced prejudice and infamy as a harmful material after a carcinogen controversy sparked in 1977 in North America. However, 30 years of studies and experiments by many scientists have proved its safety for human consumption. Additionally, WHO and other international authorities have been recognizing as well as endorsing Saccharin's safety for many years.

Saccharin is currently being used in around 100 countries as a food additive without any adverse effects.



WHY JMC SACCHARIN?

Join the global consensus on premium grade Saccharin **JMC Saccharin**

There are several Saccharin producers in the world, yet there is no other company besides JMC that boasts the longest history as well as the highest quality Saccharin production. **JMC** has over 65 years of production experience and know-how and is differentiated by using the best method for Saccharin production. JMC produces its own key raw materials for high purity Saccharin and uses potable water instead of organic solvents.

Accordingly, JMC supplies the best quality Saccharin to well-known international food companies as well as world-wide pharmaceutical companies. **JMC Saccharin**, the brand with the longest history and the best quality, works hard on benefiting its partners' interests and convenience.

JMC is naturally the right choice for your company's sweet future.



1953

JMC Saccharin's Birth

65
years

The extent of **JMC's** experience

No. 1

The Level of The Quality **JMC** Has Accomplished.



JMC's R&F Process

The optimal method for creating high quality Saccharin

JMC's premium quality starts with its choice of utilizing the Remsen & Fahlberg (R&F) Manufacturing Process. The R&F Process was originally developed by Dr. Remsen & Dr. Fahlberg when they discovered Saccharin at Johns Hopkins University in 1879. It is the foundation of JMC Saccharin's competitive advantage.

The R&F Process is differentiated from other processes in which numerous irremovable impurities are produced. The R&F Process is the optimal method for creating high quality Saccharin since it does not produce impurities other than the OTSA residue, which can be eliminated by repeated purifications with potable water. Securing the quality raw material is difficult because it requires special technical handling with dedicated facilities. These requirements are a barrier to entry for new manufacturers.

Therefore, the R&F Process is available only to producers like JMC that already has the accumulated technologies, expertise and experience. JMC, while continuing to innovate, has the longest experience with the R&F Process among all current producers.

The exclusive status of **JMC Saccharin** proves the excellence of JMC's R&F Process not only in all grocery applications but also in high-end food, beverage, personal care and pharmaceutical products.



JMC's Self-Produced OTSA

JMC's high quality Saccharin comes from the high purity raw materials.

JMC's R&F Process requires OTSA (Ortho-Toluenesulfonamide) as a raw material. By contrast, other processes use a different raw material, PA (Phthalic Anhydride), which leads to the formation of numerous impurities during the synthesis. The R&F Process is the optimal method for high quality Saccharin since it does not produce any by-products. However, OTSA, the key raw material for Saccharin, is not abundantly available in the world market. Few companies manufacture OTSA because its isomers require special handling.

JMC self-produces 99+% purity OTSA by following JMC's own quality regulations. By being completely vertically integrated JMC can stabilize its production without having problems in securing raw materials. Therefore, there is no outside factor to influence the production. Moreover, JMC monitors and controls every step in its entire process to ensure the best products that are required by our global customers.



Global Standards

JMC Saccharin complies with all Pharmacopoeias & Food standards.

JMC Saccharin conforms to all Pharmacopoeias & Food standards (USP/NF, FCC, JECFA, EP, E954, JP, KP etc.). Currently all the global standards are identifying and ruling on the quality of Saccharin based on Saccharin produced by JMC. Why is that? It is because JMC's production process is a widely proven process for high quality Saccharin. Also, JMC Saccharin is safe from CMR (carcinogenic, mutagenic or reprotoxic) and genotoxic materials. Moreover, JMC Saccharin is free from any allergen, irradiation, pesticides, GMO, BSE/TSE, gluten, latex and lactose, even though these are not regulated in Pharmacopoeias.

By contrast, Saccharin produced by the other method, using PA, contains impurities that are not measured by the current Pharmacopoeias. There are ever-increasing concerns about the risks of the impurities in Saccharin produced by processes other than the R&F method.

No Organic Solvents

JMC Saccharin is refined with potable water.

High purity OTSA is used in JMC's R&F Process and no organic impurities remain except the residual OTSA which can be refined using potable water.

JMC Saccharin is fundamentally free from toxic materials due to the impurity-free process, raw materials and purification without organic solvents. JMC uses high quality water for purification and recrystallization. JMC thoroughly manages the quality of the water by its own strict standards. In addition, our water supply is subject to regular physicochemical and microbiological examinations by the local government.

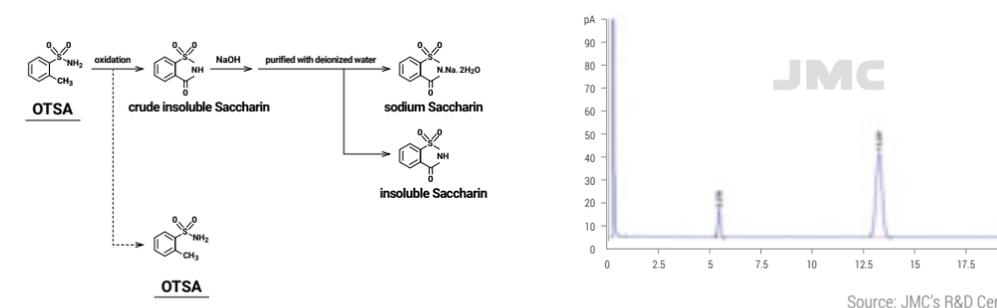
Multiple organic impurities produced from the process using PA can only be refined by using organic solvents. Even then, it is not possible to completely remove all impurities. Therefore, Saccharin produced by other methods contain various impurities as well as traces of organic solvents.



Comparison of Manufacturing Processes & Impurities

JMC's R&F Process: from the OTSA

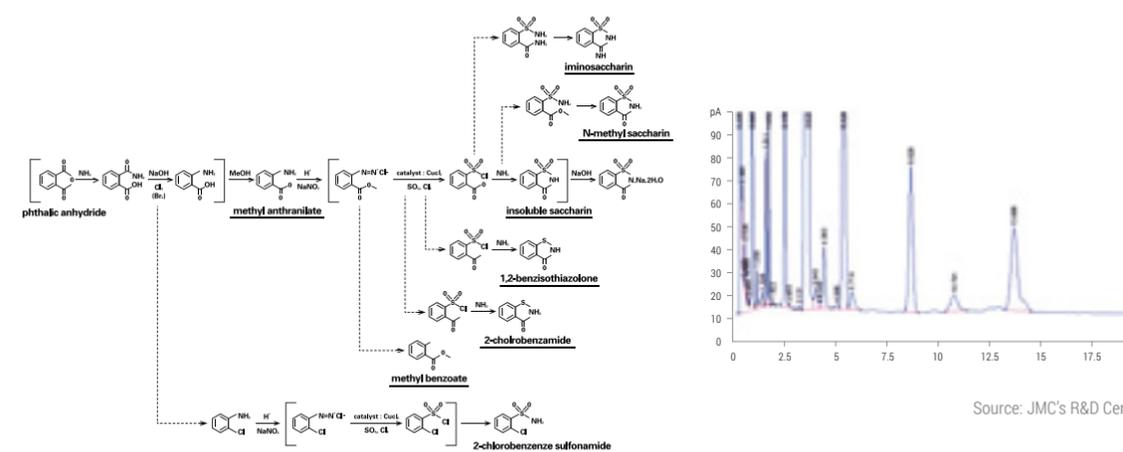
JMC Saccharin is made from OTSA and there are no impurities except the raw material. Residual OTSA is removed through purification processes involving only potable water.



Another Process (Maume Process): from Phthalic Anhydride

Saccharin produced by PA contains various impurities such as 1,2-benzothiazoline-3-one (BIT), Methyl anthranilate, Benzamide, Methyl benzoate, 2-Chlorobenzamide, etc.

These impurities remain unrefined in Saccharin.



No Impurities

There is no room for impurities in JMC Saccharin.

Since **JMC** uses OTSA, a high purity raw material, and the R&F Process, the optimal method for high quality Saccharin, there are no impurities in JMC Saccharin. By comparison, other Saccharin producers use different raw materials such as PA, which contains various impurities such as methyl anthranilic acid, produced using ammonia, sodium hydroxide, and bromine. In addition, there are other impurities such as 1,2-benzothiazoline-3-one, p-Sulphonamidebenzoic acid and many other unknown impurities that cannot be easily removed because their structures are similar to Saccharin. So, it is highly possible that these impurities still remain in Saccharin even after refinement processes.

JMC produces crude, Insoluble Saccharin through oxidation without going through other steps and refines it. This is why there are no unintended impurities in JMC Saccharin.



We care about the welfare of our staff, the safety of our products and the impact of our operations on the environment.

JMC values our employees and actively supports their health, well-being and development. All employees are provided appropriate personal protective equipment and uniforms when they work. All workers are covered by employment insurance and are treated with respect. JMC does not permit child, forced or involuntary labor at any time. JMC provides all employees with freedom of association and the freedom to choose whether to participate in collective bargaining. These fair work conditions apply across the entire KISCO group of companies, including the provision of sickness and family leave. JMC actively enforces policies to prevent social or gender-based discrimination.

JMC is committed to manufacturing using sustainable processes that do not harm our employees or our environment. The water treatment systems in our facilities are monitored and strictly controlled to comply with government regulations. Korean government environmental standards are aligned with those of other developed economies and place a strong emphasis on environmental protection.



Transparent Management

Value creation through open and genuine stakeholder engagement

- We practice transparent management. Operations that are legal and ethical are our highest priority.
- All of our business dealings are fair and honest to ensure that we maintain the trust of our shareholders, customers, employees and society at large.
- We practice a culture of management innovation that enables new technology to be developed through genuine engagement with our staff and delivers continuous improvements to our processes, products and prosperity.

Green Management

Sustainable development and fulfillment of social responsibilities

- We economically utilize natural resources such as raw materials, energy and water that are input into manufacturing activities and minimize the generation of pollutants by operating under the 3R principles (Reduce, Reuse, Recycle).
- We strictly observe domestic and overseas environmental, health and safety-related laws and other requirements applied to our company. We set strict internal standards to minimize pollutants and minimize risk factors to prevent accidents in advance.
- We promote public health by minimizing emissions of greenhouse gases and toxic chemicals by signing, implementing, periodically confirming and evaluating voluntary agreements for energy conservation and the reduction of greenhouse gas emissions.
- We have an action plan for evaluating the environmental impacts and health and safety hazards of our activities, products and services. We have environmental safety and health goals and continuously evaluate and improve the effectiveness and efficiency of them.
- We purchase raw materials that do not contain environmentally hazardous substances (such as lead, mercury, cadmium, hexavalent chromium, PBB, PBDE, CFC, etc.). We supply environmentally friendly and safe products.
- We have a response program and action plan for possible emergencies. This plan is targeted at minimizing the impact of emergencies through regular drills and active cooperation with local services.
- All employees are required to regularly review and practice their environmental, health and safety training.
- We publicly disclose our environmental, health and safety policies and performance.

Quality-oriented Management

JMC will always ensure world-class product safety and quality



- We are certified under ISO 9001: 2015, ISO14001: 2015, ISO45001: 2016, FSSC22000 (ISO22000: 2005 & ISO / TS22002-1). These include customer and legal/regulatory requirements, GMP and HACCP requirements that are applicable to us.
- We continuously monitor customer requirements and assist our partners by providing high-quality products and services that enable value-adding through improved productivity and strict quality control.
- By researching and developing ahead of time, we will supply new, high-quality sulfur-based products. We work to satisfy current customer requirements, understand future desires, maximize customer satisfaction and pursue the long-term growth of enterprises.
- Through effective communication processes, our quality assurance policies are shared with all employees and partners.
- We build, implement and continuously improve our integrated management system to meet the needs of our customers. We regularly review the adequacy, fulfillment and effectiveness of our quality assurance policies through internal audits and management reviews.
- We rapidly respond to domestic and international environmental policy changes to grow as a world-class fine chemicals manufacturer.

Food Safety Management

JMC will always ensure world-class product safety and quality

- Since its foundation in 1953, JMC has been a leader in the manufacture, sales and service of saccharin products.
- JMC takes responsibility for the entire process from product planning, manufacturing, sales, distribution and disposal.
- We are continuously developing products that can contribute to the health and well-being of our customers.
- Our products are developed in safe, hygienic facilities that are maintained to the highest standards.



JMC'S HISTORY

JMC's history of developing the world's best Saccharin

- 1953 Jeil Moolsan Company (JMC) was founded
- 1954 Established Saccharin Plant for the first time in Korea
- 1981 Moved to the new plant at the current Onsan Industrial Complex for extension of production capacity
- 1997 Acquired ISO9001 from BV (UK)
- 2004 Incorporated into Kyung-In Synthetic Corporation Group
- 2005 Acquired ISO14001 and OHSAS18001 system from BV (UK)
- 2012 Acquired FSSC22000 from SGS
- 2017 Renewed ISO9001 and ISO14001 system from ABS QE(USA)

JMC TECHNOLOGY

JMC has also been developing new technologies in Organic Synthesis to improve our existing processes and expand our product range.

1. Chlorosulfonation / sulfonation: $\text{ArH} \rightarrow \text{ArSO}_2\text{Cl}, \text{ArSO}_3\text{H}$
2. Halogenation: $\text{R-OH} \rightarrow \text{R-Cl}$ (X=halogen), $\text{Ar-H} \rightarrow \text{Ar-X}$ (X=halogen)
3. Cyanation: $\text{Ar-X} \rightarrow \text{Ar-CN}, \text{RCOX} \rightarrow \text{RCO-CN}$
4. Esterification: $\text{R-OH} + \text{R'COX} \rightarrow \text{ROCOR'}$
5. Nitration and reduction: $\text{Ar} \rightarrow \text{Ar-NO}_2 \rightarrow \text{ArNH}_2$
6. Oxime formation: $\text{RCOCH}_2\text{R}' \rightarrow \text{RCOCR}'=\text{N-OH}$
7. Benzoin condensation: $2\text{ArCHO} \rightarrow \text{Ar-CH(OH)-CO-Ar}$
8. Friedel Craft acylation: $\text{ArH} + \text{Ar'COX} \rightarrow \text{ArCOAr'}$
9. Friedel Craft alkylation: $\text{ArH} + \text{RX} \rightarrow \text{ArR}$
10. Oxidation
11. Phthalocyanine ring formation
12. Metal complexation
13. Pyrazine ring formation
14. Suzuki coupling: $\text{ArB(OH)}_2 + \text{Ar'X} \rightarrow \text{Ar-Ar'}$
15. Grignard coupling: $\text{Ar-MgBr} + \text{R-X (or CO)} \rightarrow \text{Ar-R (or Ar-CH(OH)R)}$
16. Buchwald-Hartwig reaction: $\text{Ar-NH}_2 + \text{Ar'-X} \rightarrow \text{Ar-NH-Ar'}$
17. Kumada reaction: $\text{Ar-X} + \text{Ar'-MgBr} \rightarrow \text{Ar-Ar'}$
18. Chloromethylation: $\text{ArH} \rightarrow \text{ArCH}_2\text{Cl}$
19. Radical polymerization
20. Polyester binder polymerization
21. Acrylic monomer synthesis

JMC Saccharin has gained official approvals for Quality, Safety, and Environmental Control from international authorities.



ISO 9001
Quality Management
System



ISO 14001
Environment Management
System



OHSAS 18001
Health & Safety
Management System



FSSC 22000
Food Safety System
Certification



Kosher
Certification