The End of the Steaming Era: How Extruded Technology Achieves a Leap in Nutritional Powder Quality with 1/3 of the Energy Consumption.

Detail Introduction :

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1.Market size and growth trends

The global nutritional powder market has shown strong growth in recent years. In 202 market size was $32.56 billion, and it is expected to reach $57.51 billion by 2030, wit compound annual growth rate (CAGR) of 7.4%. If broader nutritional supplements (su therapeutic nutritional powders and meal replacement powders) are included, the ma size reached $419.93 billion in 2023 and is projected to reach $976.74 billion by 2032 CAGR of 9.95%. The primary drivers of this growth are increasing health awareness, aging population, and the need for chronic disease prevention. Notably, plant-based powders are growing significantly, with pea protein holding

Regional market landscape

North America leads globally with a 35% share, primarily benefiting from the widespre fitness culture and high e-commerce penetration. The U.S. market dominates, with companies like PepsiCo (through the acquisition of CytoSport) and Herbalife solidifyi advantages through innovative products such as whey protein and functional blends. In the Asia-Pacific region, it is the fastest-growing market (CAGR exceeding 7.4%), w China's market size reaching 26.1 billion yuan. Local companies like Sanovo Health a Aland capture market share through contract manufacturing, while India and Southea Asian countries, driven by demographic dividends andconsumption upgrades, becom growth poles.

Europe holds a 20% share, ranking third, with mature markets in Germany and the U
where consumers prefer organic and sustainable products, driving demand for pea p
and hemp protein.
Emerging markets, including Latin America and the Middle East Africa, collectively ac
for 15%, with the rise of e-commerce channels (such as in Brazil and Saudi Arabia)
becoming key drivers for growth.

Market Drivers

• Aging Population: The global population aged 65 and above is projected to increase
540 million in 2021 to 800 million by 2040, driving demand for nutritional powders tail
the elderly, such as those for bone health and muscle maintenance.
• Chronic Diseases and Obesity: The global obesity rate has tripled since 1975, leadi
surge in cases of diabetes and cardiovascular diseases, which in turn boosts the den
meal replacement powders and therapeutic nutrition powders, such as those specific
formulated for diabetics.
• Fitness and Health Upgrades: The sports nutrition sector accounts for more than 50
the market, with whey protein (holding a 45% share) remaining mainstream. Howeve
based proteins (such as pea and brown rice protein) are growing rapidly due to
environmental and vegetarian trends.
• Expansion of E-commerce Channels: Online sales' share is expected to rise from 2
2019 to 40% by 2024, with platforms like Amazon and Tmall International becoming k
battlegrounds for brands.

Categorization

Category	Core function positioning	Typical recipe characteristics
Infant nutrition powder	Promote growth and development	Add nucleotides (20-25mg/100g), DHA/ARA (in a 1:1 ratio), and galactooligosaccharides (5% content)
Youth energy nutrition powder	Exercise recovery and metabolic regulation	BCAA complex formula (leucine: isoleucine: valine = 2:1:1), with conjugated linoleic acid (1.5-2%) added
Midlife nutritional powder	Improving sub-health condition	Add gamma-aminobutyric acid (50mg/100g) and Rhodiola rosea extract (standardized Rhodioloside ? 0.8%)
Nutritional powder for middle-aged and elderly people	Nutritional support for chronic diseases	Diabetes-specific: Low GI formula (glycemic index ? 35), with added chromium yeast (chromium content ? 100?g/100g)

The processof nutritional powder production line

Nutritional baby rice powder food machine list	
1	Flour mixer
2	Screw conveyor
3	Twin screw extruder
4	Air conveyor
5	Multi- layers oven (electric or gas type)
6	Conveyor
7	Conveyor/ pvc hoilst
8	Automatic grinding machine
9	Automatic powder packing machine

Raw material mixing stage

The nutritional powder production line process begins with the precise proportioning a mixing of raw materials. The flour mixer, as the core equipment, is responsible for tho mixing various grain powders (such as wheat flour, corn flour) with functional additive (vitamins, mineral premixes). The multi-layered blades inside the mixer rotate at spec angles, creating a three-dimensional motion trajectory that ensures even distribution

powder and trace components. During the mixing process, the equipment controls du
dispersion through a vacuum system and is equipped with humidity sensors to monit
moisture content of the mixture in real time, providing optimal material conditions for
subsequent processes.

Material conveying system

The mixed raw materials are smoothly transferred to the next process via a screw co
This equipment uses an enclosed trough structure, with internal spiral blades transpo
the material in a progressive manner, preventing external contamination and avoiding
powder layering. For long-distance conveying scenarios, the system is equipped with
section interlocking devices, which achieve dynamic matching with downstream equi
through variable frequency speed control.

Extrusion Process

The twin-screw extruder serves as the core processing unit, responsible for both sha
and maturing the material. After the mixed powder enters the barrel, it undergoes phy
and chemical modification under the shearing and compressive action of the screws:
granules fully gelatinize in high-temperature and high-pressure conditions, while prot
undergo moderate denaturation and reorganization. At the die exit, a rotary cutter is
equipped to cut the continuously extruded material into uniform particles, forming the
product shape. This stage uses a segmented temperature control system to precisely
the thermal mechanical action intensity in different areas.

Molding Product Transfer System

The pneumatic conveying system uses positive air pressure as the power source to g
convey expanded particles to the drying process. The system's Venturi effect design
effectively reduces particle collision damage rates, while specially designed cyclone
separators achieve clean separation of material and airflow at the end of the conveyi
process. The inner walls of the conveying pipes are polished to food-grade standards
prevent cross-contamination risks due to material residue.

Drying and curing process

The multi-layer oven achieves precise temperature control through modular design, w
each layer equipped with an independent hot air circulation system. The expanded pa
undergo gradient drying on the conveyor belt: the upper layer's high-temperature zon
quickly sets the outer structure, the middle layer's constant-temperature zone comple
internal moisture migration, and the lower layer's low-temperature zone performs fina

moisture balancing. The equipment is fitted with waste gas recovery devices that use
emitted heat to preheat incoming air, creating an energy-saving closed loop.

Powder preparation stage

The automatic grinder uses a multi-stage crushing principle. It first breaks dry particle
coarse powder using high-speed impact hammers, then separates the powder that m
the required fineness through a turbo classifier. The equipment is equipped with an ir
temperature monitoring system that automatically activates the cooling device when t
temperature in the crushing chamber exceeds the set threshold, preventing the loss o
sensitive nutrients.

Finished product packaging stage

The fully automatic powder packaging machine integrates weighing, filling, and sealin
functions. The screw dosing device uses photoelectric sensing technology to precisel
control the weight, while the vibration alignment mechanism ensures that the bag ope
fully extended. The heat sealing unit employs pulse heating technology to quickly sea
bags at low temperatures, ensuring strong seals while avoiding the impact of high
temperatures on nutritional components.

System integration control

The entirenutritional powder production line is interconnected through a central contro
system, with data exchange between devices via industrial buses. The visual operatio
interface displays the real-time status of equipment, triggering a three-level alarm
mechanism (audible and visual alerts, automatic deceleration, emergency shutdown)
of anomalies. The cleaning module uses a CIP online cleaning system to automatical
and sterilize equipment pipelines according to preset programs.

This process design fully embodies the continuous and closed characteristics of mod
food processing, forming a complete closed loop from raw material input to finished p
output. Through intelligent collaboration between devices, it ensures the stability of p
physical and chemical indicators while meeting hygiene requirements for food safety
production, suitable for large-scale production of various nutrient-enriched powdered
products.



Comparison between traditional steaming and modern extrusion puffing techno

Essential Differences in Process Flow:

1. Traditional Steaming Process

Based on intermittent physical processing principles, it follows a segmented operatio of 'pre-treatment - static steaming - air drying':

? The material undergoes prolonged wet heat treatment (usually 40-60 minutes) in a pressure steam environment, with starch gelatinization relying on moisture penetratio heat conduction.

? After maturation, the material needs to be naturally air-dried or dried with hot air (2- hours) to reduce moisture, which can easily lead to nutrient loss and microbial contar risks.

? Each process step relies on manual transfer, involving multiple exposure stages.

2.Modern extrusion technology

Modern extrusion expansion technology employs a continuous thermal-mechanical processing mode, integrating "transportation-shearing-maturation-forming" into one process:

?The material undergoes high-temperature (120-180?), high-pressure (3-10MPa) trea for a short duration (30-50 seconds) within a sealed screw system, where mechanica shearing causes the breakdown of starch molecular chains.

?The flash effect during expansion rapidly reduces moisture content from 18% to 8% eliminating the need for separate drying steps.

?The entire process is conducted in a fully enclosed pipeline system, ensuring that th material is never exposed midway.

Equipment Structure and Energy Consumption Characteristics

Traditional steaming equipment:
Traditional steaming equipment consists of independent steaming cabinets, drying ro and other units, occupying a large area. The steam boiler accounts for more than 60% total system energy consumption, with a thermal efficiency of less than 40%. The comprehensive energy consumption per ton of product is about 200-250kW·h, with a 30% of the energy lost through equipment heat dissipation.

Extrusion system: It features modular design integrating feeding, extrusion, and cuttin
increasing space utilization by 50%. The self-generated heat effect (friction heat) redu
external thermal energy input, with electricity accounting for no more than 20%. An e
recovery device can use the residual heat from exhaust gases to preheat raw materia
reducing the comprehensive energy consumption to 80-100kW·h per ton.

item	Traditional steaming equipment	Extrusion system
starch pastillation	70-80%	92-98%
protein denaturation rate	25-35%	8-15%
Product Density	0.6-0.8g/cm³	0.2-0.4g/cm³
Dissolving time	60-90 seconds	10-15 seconds
microbiological control	Preservative required (0.1-0.3%)	Puffed and instantly sterilized (no additives required)

Technological Upgrade Value

Increased Production Efficiency

? Continuous production has increased daily capacity from 5 tons to 20 tons

? Reduced need for operators by 60%, with automation reaching 85%

2. Nutrient Retention Innovation

? Vitamin C retention rate increased from 55% to 82%

? Probiotic survival rate exceeds 90% (microencapsulation combined with low-temp extrusion)

3. Sustainability

? Carbon emission intensity reduced by 40% (energy consumption decrease + addi packaging)

? Byproduct (trimmings) recovery rate increased to 95%

The comparison shows that extrusion-expansion technology realizes a paradigm ch food processing through the reconstruction of physical fields, and its character "energy saving, cleanliness and high efficiency" perfectly fit the needs of the transfo and upgrading of the modern food industry. In the future, with the populariz intelligent temperature control systems and flexible screw design, this technology w greater potential in the field of personalized nutritional powder manufacturing.

FAQ:

?What does after-sales service include?

A: • Basic services:

? Free installation and commissioning + operation training

? 1-year full machine warranty

• Value-added services (optional):

? Remote monitoring system (real-time fault diagnosis)

? Annual maintenance plan

?Does the equipment meet food safety certification requirements?

A: Certifications: CE, FDA, ISO 22000 certifications.

Material Safety: All parts that come into contact with food are made of 304 stainles
eliminating any risk of contamination.

?How automated is the production line? Is it necessary to have a technician operate

A: • Automation level:

? The entire process from raw material input to packaging is fully automated, r
only manual input of raw materials and random inspections.

? Touchscreen control allows for one-button start-up after parameter settings.

• Operational difficulty:
? Ordinary workers can be trained to operate within 1 to 3 days.
? We provide operation manuals in both Chinese and English along with a fault code