

S. K. Patil and Associates

Clean Label Starches:

- 1. Physically Modified Starches***
- 2. Enzyme Modified Starches &***
- 3. CWS (cold water swelling) Starches***

***Process, Applications, Products and Markets
April 2014***

Sample



***By: Sakharam K. Patil, Ph.D.
April, 2014***

Clean Label Starches:

- 1. Physically Modified Starches***
 - 2. Enzyme Modified Starches &***
 - 3. CWS (cold water swelling) Starches***
- Process, Applications, Products and Markets***
March 2014

TABLE OF CONTENTS

	Page No
REPORT SCOPE.....	6
INTRODUCTION.....	8
<i>1. Physically Modified Starches</i>	
I. EXECUTIVE SUMMARY.....	19
II. PHYSICALLY MODIFIED STARCH – PROCESS AND PROPERTIES	
BRIEF DESCRIPTION.....	21
A. Process.....	22
B. Properties.....	25
III. APPLICATIONS, MAJOR CUSTOMERS AND PRICE POINTS.....	29
IV. MARKETS, MANUFACTURERS, PRODUCT VOLUMES AND PRICE POINTS.....	32
A. Market.....	32
B. Products.....	36
C. Resistant Starch (RS) and Slowly Digestible Starch (SDS).....	43
D. Clean Label Opportunities – Published News Articles.....	45
V. OPPORTUNITIES & TRENDS.....	52

VI. PHYSICALLY MODIFIED STARCH RECENT SELECTED RESEARCH, TECHNOLOGY AND MARKET DEVELOPMENT ACTIVITIES.....	54
A. Selected Abstracts.....	54
B. Physically Modified Starch Selected Patents.....	63
VII. SUMMARY.....	82

2. Enzyme Modified Starches

I. EXECUTIVE SUMMARY.....	85
II. PROCESS AND PROPERTIES BRIEF DESCRIPTION.....	87
III. MARKETS, MANUFACTURERS AND PRODUCTS.....	100
A. Market.....	100
B. Products and Applications Enzymes in Clean Label Applications.....	103
C. Enzyme Modified Starch Product Launches.....	113
D. Resistant Starch (RS) and Slowly Digestible Starch (SDS).....	120
E. Microbial Polysaccharides with SDS/SDC Properties.....	123
IV. SELECTED RESEARCH AND TECHNOLOGY DEVELOPMENTS IN ENZYME MODIFIED STARCHES.....	125
A. Selected References and Abstracts.....	126
B. Enzyme Modified Starch selected patents.....	143
V. SUMMARY & REFERENCES.....	157

3. CWS (cold water swelling) Starches

I. EXECUTIVE SUMMARY.....	160
II. COLD WATER SWELLING (CWS) AND SPRAY COOKED STARCH.....	161
A. CWS/Spray cooked starch process and properties brief Description.....	163
B. Selected Properties.....	167
III. APPLICATIONS, MAJOR CUSTOMERS AND PRICE POINTS.....	168
A. Applications.....	168
B. Uses.....	169
C. Major applications.....	169
IV. MARKETS, MANUFACTURERS, PRODUCT VOLUMES & PRICES.....	171
A. Major CWS manufacturers and market.....	172
V. PRODUCTS BY MANUFACTURERS.....	174
VI. OPPORTUNITIES & TREND.....	178

VII. CWS STARCH SELECTED RESEARCH, TECHNOLOGY AND MARKET DEVELOPMENT ACTIVITIES.....	180
A. Selected Abstracts.....	180
B. Selected Patent Summaries.....	183
VIII. SUMMARY.....	191
GENERAL SUMMARY – Reports 1, 2, and 3.....	192

SUMMARY - *Clean Label Starches* – Report 1, 2, and 3

Clean/Simple label on the foods as a marketing tool and to offer value added option is the most important are in recent food markets. This timely 200 page ***Clean Label Starches Report*** is combination of three separate groups of starches; Physically Modified, Enzyme Modified and the CWS starches prepared as reports 1, 2 and 3 separate reports. All three reports are enhanced to include the latest development, applications and the market information. Food formulators, marketers and the R & D teams can develop excellent approaches in their clean label product development capabilities. Our in-depth researches, expert analysis in the areas of clean label starches has supported our clients, have helped technical and business professionals in R & D, marketing and purchasing make the right strategic decisions.

In response to consumer demands, manufacturers are trying to simplify ingredient lists by removing and replacing artificial additives. There are a range of projects trying to find technical solutions that enable manufacturers to produce so called "clean label" products. Reports present most pertinent materials on the highest value modified starches mainly for food applications.

1. Physically modified starches;
2. Enzyme modified starches AND;
3. CWS – Cold Water Swelling Starch

1. Physically Modified Starch

Physically modified starch were developed a few year ago are now well established. The products and technologies continue evolve Besides Ingredion, several other players from the US and EU have entered this markets. Physically modified starches perform similar to chemically modified starches in food applications. Physically modified starches represent the greatest opportunity for growth in the starch industry. As the desire to provide cleaner labels or “pantry friendly” ingredients grows, there is a significant interest in these products by all major food manufacturers. Growth is driven by “Organic”, “Natural” and “Clean Label Foods”. New technologies and new products will continue to come to market going forward.

Physically modified starches represent a great opportunity for growth in the starch industry. As the desire to provide cleaner labels or “pantry friendly”, “clean label” ingredients increases, there is a significant interest in these products by all major food manufacturers.

Ingredion/National Food Innovations owns this market with a total of 20 starch products based on waxy maize, tapioca, waxy rice and potato, 4 wheat flours and blend options. In 2013 the total current market in the US from all producers was estimated at ~ 60 million lbs and growing at about 6 to 8 % in the past 2 yrs after a strong growth of > 10 % in the previous 3 yrs (2009 & 2012). US have ~ 40 % of the market share of this group of modified starches. Primary driver is “Natural” and “Clean label” This report is the most recent information compiled that provides an excellent review of this new novel food ingredient group. Taking into account of growth in natural, organic, simple/clean label and wellness products potential going forward physically modified starches can account for 4 to 5 % of total food modified starches worldwide to ~ 250 to 300 million pounds in 5 to 6 yrs. This seems an aggressive estimate, however it is achievable.

2. Enzyme modified starches

Enzyme modified starches remain an active area in the functional modified starches. This group is projected to be the greatest area of growth in starch derivatives, mainly attributed to the demands of clean/simple label in foods going forward. Enzyme modification can be tailored to very specific properties because of specificity of enzyme attack and very selective modification of targeted food and industrial segment applications demands going forward. This starch category can also qualify for “clean label” products if chemical modification is not utilized with enzyme modification.

This group of starch introductions is very new. Depending on the food product categories we estimate the growth of 5 to as much as 10 % during 2013 and 2014 for all segments (several new product introductions). We estimate 2013 market as 3 million pounds with the growth estimated at 7 % 2015 to 2017 to ~ 13 million pounds for all food segments. We assigned this value based on the growing need for clean label starches, and aggressive technical/commercial strategies by current and new players entering this market. This is also enhanced by targeted enzyme function, the benefits, modification technologies and potential new sources of tailor made enzymes for specific

Besides the use in starch hydrolysis, starch-converting enzymes are also used in a number of other industrial applications, such as laundry and porcelain detergents or as anti-stalling agents in baking. A number of these starch-converting enzymes belong to a single family: the α -amylase family or family13 glycosyl hydrolases. Starch modification by enzymes is in its'

infancy with very insignificant commercial products. However due to their novel functions, clean label needs and cost efficiencies/environmental issues in industrial segments such as paper, detergents, etc growth will enhance as science and market develop go forward.

A plant and chemical-free alternative to gelatin is amyloamylase-(AM) glucanotransferase; E.C. 2.4.1.25) modified starches that are expected to find application in the food industry. AVEBE launched in 2007 an AM-modified potato starch that is used as fat replacer and enhancer of creaminess in yogurt. The search for a gelatin-replacer has been ongoing for many years, and several potential polysaccharide-based alternatives for the food industry.

There is a large industrial interest in replacing expensive or otherwise unwanted gel formers such as gum arabic, pectin and gelatin with starch in food products. Starch is an alternative, but amongst the known problems of native starch are sub-optimal textural properties. A starch company, AVEBE, remains a strong player with several new enzyme modified technologies going forward.

It is difficult to predict whether all of the proposed enzymatic starch processing technologies will be implemented by the food industry, but it is fair to say that the Etenia™ starch made by 4 α -GT treatments are commercially available and are increasingly being used as food ingredients. In the future, novel enzyme activities that are capable of slowing down the degradation of starch in the gastrointestinal tract may create new routes toward healthy starches. Such enzymes can thus replace chemical steps that introduce cross-linkages in starch.

3. CWS – Cold Water Swelling Starch

The CWS starches are generally not clean label because their process involves alcohol treatment and certain chemical modifications e. g. Octenyl Succinic Anhydride. We have included this report because of their specialty applications and great interest in their use in the current new product trends that require flavor encapsulation and beverage emulsion, among others.

Cold water swelling and spray cooked starches are marketed heavily for instant preparation, flavor encapsulation and convenience aspects of food preparation. Granular cold water swelling/soluble starches are produced by treatment with an alcohol and a strong base to effect swelling of the starch granules and conversion to a form having increased cold water solubility. Specialty starches labeled instant, granular or cold water-swelling hydrate at lower temperatures and eliminate the heating step. In addition to convenience and significant savings in time, labor, energy and equipment, these also improve the quality of delicate products normally harmed by heat.

Total US market for cold water swelling/spray cooked starches in 2013 was estimated to be > 90 million pounds and growing at the rate of ~ 5 % worldwide. This includes a wide variety of typical food applications as well as specific specialty applications. Three segments; convenience, dairy and bakery utilize almost 50 million pounds with one user using ~ 17 to 18 million lbs in single application, pudding. Our projection is that CWS starch consumption will grow > 100 million lbs by year 2017.

Finally, Research activities presented in the form of selected research paper abstracts and patents show activities in several fronts; convenience, health/nutrition, novel flavor

encapsulation, new tastes, natural clean labeling and dairy among other growing trends worldwide going forward.

We recommend our other starch industry reports that come from many years of the expertise of our team, the insides of this industry with a lot of data and insights for technical, marketing, supply chain of ingredient and consumer products companies as training tools and as valuable resources.

1. *STRATEGIC REVIEW OF GLOBAL CORN STARCH INDUSTRY & MARKETS - STARCH DERIVATIVES, SWEETENERS, CO-PRODUCTS AND BIOPROCESSING August, 2014*
2. *Global Modified Starch Products, Derivatives & Markets – A Strategic Review – August, 2014*
3. *Dextrins: Food & Industrial Products, Applications, Markets and Industry Situation – August, 2014*
4. *Clean Label Starches: 1. Physically Modified Starches, 2. Enzyme Modified Starches & 3. CWS (cold water swelling) Starches Process, Applications, Products and Markets April, 2014*

S K PATIL & ASSOCIATES, INC.
sakharam@skpatilassociates.com
sakharam@sbcglobal.net
219-922-1033
www.skpatilassociates.com

April, 2014