Preview of Comprehensive Castor Oil Report

A report on castor oil & castor oil derivatives

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CastorOil.in
C/O Clixoo
Anugraha, 41, NH Road, Nungambakkam
Chennai – 600034, Tamilnadu. India
Phone: +91-44-45590142
Mobile: +91-98413-48117
Email: narsi@clixoo.com
Web: www.castoroil.in

An Invaluable Guide to the Castor Oil and Castor Oil Derivatives Industry

Castor oil is possibly the plant oil industry's most underappreciated asset. It is one of the most versatile of plant oils, being used in over ten diverse industries. Owing to its unique chemical structure, castor oil can be used as the starting material for producing a wide range of end-products. The plant itself requires relatively less fertilizers, pesticides, water and maintenance than most other cultivated crops, and it can grow in marginal land. With so many unique advantages, one would expect the castor crop to be widely grown world over. Strangely, it is not so.

This is all set to change, as many companies, entrepreneurs and governments are waking up to the potential of the castor crop, castor oil and castor oil derivatives. In the past few years alone, a number of countries which have little or no land under castor cultivation have started making serious exploratory efforts at growing castor. A number of companies are doing cutting edge research on the use of castor to produce bioplastics and biopolymers such as polyurethane, nylon and more. With the increasing use of biolubricants and bio-greases, castor oil is emerging as the preferred feedstock choice, owing to the already prevalent applications of castor oil derivatives for these purposes.

These accelerated research and commercial efforts in castor oil require a comprehensive information support resource that will ensure that all the relevant and critical information on the product, industry and market are available to the relevant entities. The Comprehensive Castor Oil Report was developed in order to satisfy this clear need.

The Comprehensive Castor Oil Report is the most detailed report dealing with all aspects of the castor oil industry. The report focuses on providing detailed insights on the following aspects:

Production	• detailed inputs on the technology and processes for producing all major castor oil derivatives
Market segments	• inputs on the key end-user market segments
Cultivation	• extensive details on the critical aspects of castor crop cultivation
Companies	• profiles and details on the leading companies in this industry

The objective of the Comprehensive Castor Oil Report is to facilitate tangible steps for a castor oil venture. The emphasis hence is on providing practical data, updates and insights.

The report has been developed with over three years of in-depth research, and has been developed with inputs from castor oil industry experts, chemical engineering researchers, and professionals who have been constantly interacting with the castor oil industry for over a decade.

The Comprehensive Castor Oil Report will be an invaluable guide to those keen on venturing into an industry with exciting future potential.

Chapter 1 Castor Oil Manufacturing

The production process for the basic grades of castor oil are well known and well established. There are however a number of innovative processes and emerging technologies for the production of value added castor oil chemicals and derivatives. This chapter provides detailed inputs on the production processes of castor oil, its basic grades and for a diverse range of castor oil based derivatives and chemicals.

Key Sections

SAMPLE TOPIC

Production Process for Dehydrated Castor Oil

Dehydrated Castor Oil

Castor oil has only one double bond in each fatty acid chain and so is classified as non-drying oil. However, it can be dehydrated to give semi-drying or drying oil which is used extensively in paints and varnishes. Being a polyhydroxy compound, its hydroxyl functionality can be reduced through dehydration or increased by inter-esterification with a polyhydric alcohol.

It must be noted that coatings that incorporate castor oil alone will never achieve complete cure through oxidative cross-linking as do coatings that contain oil with multiple double bonds in their fatty acid components. For this reason, dehydrated castor oil assumes special significance.

The dehydration process is carried out at about 250^{o}C in the presence of catalysts (e.g., concentrated sulphuric acid, activated earth) and under an inert atmosphere or vacuum. Under this condition of dehydration, the hydroxyl group and adjacent hydrogen atom from the C-11 or C-13 position of the ricinoleic acid portion of the molecule is removed as water. This yields a mixture of two acids, each containing two double bonds but in one case, they are conjugated. The presence of an acid containing conjugated double bonds results in an oil resembling tung oil in some of its properties. Thus, castor oil, which is non-drying, can be treated and converted into a semi-drying or drying oil known as dehydrated castor oil.

Details of manufacturing the following castor oil grades & derivatives are also explained in this chapter

- Industrial / Commercial Castor Oil
- First Special Grade Castor Oil
- Cold Pressed Castor Oil
- Pale Pressed Castor Oil
- Pharma Grade Castor Oil
- Hydrogenated Castor Oil
- Sulfonated Castor Oil
- Blown Castor Oil
- Ricinoleic Acid
- 12-HSA
- Methyl 12-HSA
- Sebacic Acid
- Undecylenic Acid
- Methyl Ricinoleate
- Methyl Undecylenate
- 2-Octanol
- Heptaldehyde, Heptanoic Acid & Heptyl Alcohol

Chapter 2 Castor Oil Market

The end user market for castor oil and castor oil derivatives is already quite diverse. With new applications of castor oil being explored, especially in areas such as pharmaceuticals and biopolymers / bioplastics, these end user markets for castor oil and its derivatives are expected to expand significantly over the next few years. This chapter provides insights into the characteristics and dynamics of the castor oil, chemicals and derivatives markets, supported by rich data and analysis. A detailed demand-supply analysis of the key castor oil chemicals and derivatives is also provided.

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SAMPLE TOPIC

Demand & Consumption of Castor Oil

The major consumer countries of castor oil with their annual consumption figures (in Metric Tons) – 2006-07

	Oct-Sep 09/10 F	Oct-Sep 08/09	Oct-Sept 07/08	Oct-Sept 06/07	Oct-Sept 05/06	Oct-Sept 04/05	Jan-Dec 2009	Jan-Dec 2008	Jan-Dec 2007	Jan-Dec 2006	Jan-Dec 2005
France	2.0*	3.4*	24.0*	3.0*	4.0 *	15.0*	0.7*	22.0*	2.0*	2.5*	9.0*
Germany	1.5*	2.0*	2.0*	1.5*	1.5*	1.0*	2.0*	1.6*	0.8*	1.5*	1.0*
U.K	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*
EU-27	3.6*	5.5 *	26.1*	4.6*	5.6*	16.1*	2.8*	23.7*	2.9*	4.1*	10.1*
Russia	0.4*	0.3	0.3	0.3	0.3	0.3*	0.4*	0.5*	0.4*	0.5*	0.1*
U.S.A	9.0*	13.1	11.8*	8	16.3	17	10	17.7	16.7	20.5	13
Brazil	3.0*	3.0*	8.0*	2.0*	8.3*	8.0*	1.0*	4.0*	1.0*	6.2*	10.9*
China,PR	13.0*	11.0*	15.0*	8.0*	11.0*	9.0*	16.0*	6.0*	9.0*	14.0*	9.0*
India	20.0*	27.0*	8.0*	9.0*	24.0*	9.0*	15.7*	15.0*	3.0*	3.0*	8.0*
Japan(c)	4.0*	2.8	5.7	2	2.7	4.3	2.5	2.8	1	2.3	5
Other Countries	1.7*	1.8*	1.5*	1.7*	1.5*	1.3*	5.4*	5.5*	5.4*	5.5*	5.6*
Total	**54.3**	**64.2**	**76.1**	**35.3**	**69.4**	**64.7**	**53.4**	**74.7**	**38.9**	**55.6**	**61.5**

Source: Oilworld
Note:* oilworld estimates

The leading countries in the list of imports of castor oil with their importing figures (2006-2007)

(All figures in 1000 Tons)

China	125
European Union (27)	114.7
USA	38
Japan	15
Thailand	14
Others	9.5

Future demand-supply estimates for the various grades of castor oil and derivatives

Growth of Key End-User Segments

The major end-use industries for castor oil derivatives castor oil are:

- Lubricants & Greases
- Coatings
- Personal Care & Detergent
- Surfactants
- Oleochemicals

Growth of Key End-user Industry Segments for Castor Oil Derivatives

Industry	% Growth (CAGR), based on 2005 data	Potential
Lubricants & Greases	2	44 million T by 2012
Coatings	4.9% (about 11% in Asia!)	-
Personal Care & Detergent	6%	$375 billion by 2012
Surfactants	4%	$16.65 billion by 2012
Oleochemicals	4%	8.5 million T by 2012

Detailed information on castor oil market, castor oil production worldwide and current and future demand- supply estimates of castor oil and its derivatives are provided in this chapter. The chapter also talks in detail about the castor industry in India.

Chapter 3 Castor Oil Chemicals & Derivatives

Castor oil derives its unique properties from its distinct chemical structure. Many of the valuable derivatives of castor oil also owe their advantages to this unique structure. Data on the chemical structure and composition of the derivative are crucial to determine its suitability for specific applications and end uses. This chapter provides detailed inputs on the chemical structures, compositions and properties of castor oil, its various grades, and the diverse chemicals and derivatives.

Key Sections

SAMPLE TOPIC

Chemical, Physical Properties & Specifications of Castor Oil Grades & Derivatives

Commercial Grade Castor Oil

Appearance	Pale Dark Yellow
Colour in 1" Cell, Y+5R Lovibond	30 units max.
Iodine Value	82 – 90
Saponification Value	177 – 187
Hydroxyl Value	160 min.
Acid Value	2.0 max.
Moisture & Volatiles	0.50% max.
Specific Gravity @ 20° C	0.954 – 0.967

BP Grade Castor Oil

CAS No	8001-79-4
EINECS	292-293-8
Colour	Nearly Colourless or Faintly Yellow
Relative Density at 20ºC	0.952-0.965
Moisture	0.3% max.
Iodine Value	82-90
Saponification Value	176-187
Acid Value	2.0 max.
Unsaponfiables w/w	0.8% max.
Optical Rotation	between +3.5º and 6.0º
Hydroxyl Value	150 min.
Peroxide Value	5.0 max
Light Absorption	1.0 max

Detailed insights on unique properties of castor oil and its derivatives are provided in this chapter.

Chapter 4 Castor Oil Prices

Castor oil and castor seeds are known for the volatility in their prices. Castor crop cultivators, castor oil derivatives producers, and consumers have a critical need to factor in this price volatility in their business modeling and planning. This chapter provides detailed inputs on the historical prices and price variations of castor seeds and castor oil, and also an analysis of factors that are responsible for this volatility.

Key Sections

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- Castor Oil Prices
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4.3 Factors that Affect Prices
- Characteristics of Castor Seed and Oil Market
- Market Influencing Factors in Castor Trade

4.4 Castor Oil Futures Market

SAMPLE TOPIC

Historical & Current Price Data for Various Grades of Castor Oil, Castor Seeds

Castor Oil Prices (average price for commercial grade) – US$/T, FOB Mumbai

Year	2002	2003	2004	2005	2006	2007	2008 (Feb)	2008 (Jun)	2009 (Jan)	2009 (Jun)	2010 (Jan)
Price	675	925	850	925	775	1025	1160	1350	1050	1104	1330

A Snapshot of Castor Seed, Castor Oil & Castor Cake Prices in Jul/Aug 2008 and Jan 2009

All castor products hit a record high in Jul/Aug 2008. A look at the average prices below will tell the story.

All prices in US $ / Metric Ton, FOB India

Product	Price
Castor seed	700
Castor oil	1500
Castor cake	110

Historical and current price details are provided for castor seed and oil. This chapter also talks about price volatility in castor seed & oil and the factors that affect prices and influence castor trade.

Chapter 5 Castor Cultivation

Compared to many other crops, castor crop requires relatively fewer inputs such as water, fertilizers and pesticides. The crop can also be grown on marginal land, thus providing an excellent opportunity for many regions of the world to utilize their land resources more productively. At the same time, following proper procedures during sowing and maintenance will result in much high crop yields than otherwise. In addition, use of high-yield hybrid varieties also can have a positive effect on crop and seed yields. This chapter provides critical inputs on all aspects of castor crop cultivation, maintenance and harvesting, with an emphasis on the key success factors that will result in high yields.

Key Sections

5.1 Introduction
5.2 Castor Crop Sowing
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- Land Preparation
- Sowing

5.3 Castor Crop Growth
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  - Rainfall
  - Irrigation
- Climate
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5.4 Castor Crop Harvest
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International Germplasm Center
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- Castor Seed Yield
- FAO Data for castor seed yields (2006)
- Castor Oil Yield

5.8 Castor Cultivation FAQ

SAMPLE TOPIC

Castor Seed Varieties & Hybrids

Some Short Term (annual) Varieties Tested in East Africa

Variety	Time To Maturity
II23	7-10 Months
UC53	7-10 Months
Baker 44	5-7 Months
Baker 22	5-7 Months
Lynn	5-7 Months

Advantages of annual varieties: Higher yield potential, seeds seldom shatter and have uniform hull strength and thickness.

Disadvantages of annual varieties: Pest susceptibility

Castor Cultivation FAQ

1. Why is castor an annual crop while it is actually a perennial?
2. Is harvesting done manually or is it automated?
3. Intercropping of castor with other plants?
4. What are the safety laws that are followed in the castor industry – especially in areas where people come in contact with the seeds and/or castor meal?
5. Is spreading castor meal as fertilizer not a problem to those who spread it?
6. How resistant is the crop to salinity?
7. What are the fertilizers commonly used for castor crop cultivation?
8. Provide more details on castor meal as fertilizer
9. Is organic castor oil produced anywhere?
10. How is soil fertility maintained?
11. Is there a danger to the flora and fauna in the region owing to the toxicity of castor beans?

This chapter explains in detail about castor crop cultivation and also provides yield data under different soil and climatic conditions

Chapter 6 Castor Oil End-uses

The ever-expanding end uses of castor oil and its derivatives make it imperative for businesses and companies to have an updated and comprehensive knowledge of the various applications of each castor oil derivative. This chapter provides extensive details on the current, emerging and future possible end-use applications of castor oil and its derivatives. Special emphasis is given to providing real-life and exclusive data for niche applications such as the use of castor oil to produce polyurethane, nylon 6 and nylon 11. A detailed evaluation is also provided on the suitability of castor oil as a biodiesel feedstock.

Key Sections

- Castor Oil Derivatives for Other Plastics
- Research & Trends in Castor Oil Based Biopolymers

6.2.2 Castor Oil as a Feedstock for Biodiesel

- Can castor oil become an efficient bio-fuel and bio-diesel?
- Cost of Castor Oil
- Evaluation Table for Castor Oil as Biodiesel Candidate
- Preliminary Inference for "Can Castor Oil Make a Good Biodiesel?"
- Some useful research info on biodiesel from castor oil

6.2.3 Other Possible Future Uses

SAMPLE TOPIC

Current End Uses for Castor Oil & Derivatives

12-HSA

12 HSA is used in grease manufacture, plastics lubrication and as a raw material for the synthesis of more complex chemicals. It is used as a high hydroxyl castor based wax, as a wax ingredient.

When reacted with an ester, 12 HSA provides a hard finish for the automotive and small appliance industries.

Both HCO and 12 HSA have enjoyed popularity with the growth of lithium complex greases, which are growing to be the largest segment of the grease market. These greases have excellent heat tolerance like the sodium greases and the water resistance of calcium greases. The addition of 12 HSA enhances the overall performance with better texture, improved heat stability and improved dropping points. It simplifies the grease manufacturing process because it no longer requires milling and homogenization steps that were normally used with lithium type greases.

12 HSA soaps are used in mineral oil-based multipurpose greases making it possible for grease to fill the requirements of a variety of needs in the automotive and truck greases.

In cosmetics: 12 HSA may be used for gelling liquid petroleum to produce brilliance. It may be incorporated into cold creams and vanishing creams to give a jelly-like feeling.

In paints: 12-HSA is reacted with acrylic esters to produce hard, durable thermosetting polymers used in high-quality automotive, industrial appliance and metal decorative finishes.

In rubbers: 12-HSA functions as an activator and internal lubricant for natural and synthetic rubbers.

Nylon 11

The process to make Nylon 11 from castor oil is quite involved and includes several reaction steps, but briefly, it is as follows:

Castor oil is converted to methyl ricinoleate by treatment with methyl alcohol. Methyl ricinoleate is pyrolysed at high temperature yielding heptaldehyde, methyl undecylenate and a small amount of fatty acids. Methyl undecylenate is hydrolysed to produce undecylenic acid. When undecylenic acid is treated with hydrogen bromide in a non-polar solvent in the presence of peroxide, reverse Markownikoff addition occurs and the main product is x-bromoundecanoic acid. This is then treated with ammonia to give x-aminoundecanoic acid, which is a crystalline solid. Aminoundecanoic acid is the starting material for nylon-11.

Castor Oil Use in Cosmetics & Perfumeries

End Products	*Castor Products & Derivatives Used*
a. Perfumery Products b. Lipsticks c. Hair Tonics d. Shampoos e. Polishes f. Emulsifiers g. Deodorants	a. Castor Oil b. Castor Oil Esters c. Undecylenic Acid d. Castor Wax e. Zinc Ricinoleate f. Heptaldehyde g. Heptanoic Acid h. Undecylenic Acid i. Heptyl Alcohol j. Ethyl Heptoate k. Heptyl Acetate

The scope of applications and potential markets for castor oil and its derivatives are explained in this chapter. Profiles of end users of castor oil derivatives are given. In addition, this chapter also analyzes castor oil's suitability as a replacement for biodiesel.

Chapter 7 Castor Seeds

A number of research efforts have been initiated towards development of hybrid and high-yield castor seeds. These efforts will be crucial in expanding the crop cultivation worldwide. This chapter provides key inputs related to castor seeds, and has a special emphasis on providing critical data that will be of special interest to those keen on exploring investing in this industry – data related to prices, and inputs on castor seed varieties including trends in hybrid castor seeds.

Key Sections

SAMPLE TOPIC

Castor Seed Prices & Trends

The average spot prices provided for specific months over a 3 year period to demonstrate the increase and volatility in prices

Year	Average Price ($ / T)	Year	Average Price ($ / T)
2005 May	400	2009 Mar	490
2005 Nov	330	2009 Jul	540
2006 Mar	340	2009 Nov	640
2006 Jul	340	2010 Mar	640
2006 Nov	400		
2007 Mar	460		
2007 Jul	480		
2007 Nov	500		
2008 Jan	510		
2008 Mar	600		
2008 Jul	700		
2008 Nov	650		

Apart from price details, this chapter also talks about castor seed production and supplies in major countries for the past ten years.

Chapter 8 Castor Meal

Castor meal makes an excellent bio-fertilizer owing to its optimal composition of nutrients (especially N-P-K). The toxicity in castor meal makes it unsuitable for use as animal feed, thus resulting in a lower price for the meal while compared with prices of competing oilseed-meals such as soymeal or rapeseed meal. This combination of high fertilizer value and a low price has resulted in an ever increasing demand for castor meal from the organic fertilizer market worldwide. This chapter provides details on composition, supply/demand, price data and related commercials for castor meal.

Key Sections

SAMPLE TOPIC

Toxicity in Castor Meal

The castor cake is mainly used as a fertilizer. It is unsuitable as an animal feed because of the presence of toxic protein called ricin and toxic allergen often referred to as CBA (castor bean allergen). However, it is noteworthy that none of the toxic components is carried into the oil.

Some methods for the detoxification of the cake have been attempted. These include

- Treatment with ammonia, caustic soda, lime and heat.
- When the cake is steamed, the ricin is detoxified and the allergen is inactivated.
- Another method of detoxifying castor seed meal involved the wet mixing with sal seed meal so that the toxic constituents of castor seed were neutralized by tannins.
- Detoxified and deallergenized castor meal (DDCM) is a by-product of an extraction process of the castor bean in Thailand, introduced in the 1990s. It has been claimed that DDCM can be safely used as animal feed. It is claimed that the extraction process is done in such as way that due to the action of heat, together with some base solubles, the castor meal is rendered non-toxic.

- In addition, some people in parts of South-Eastern Nigeria have long developed a method for treating and detoxifying the unextracted seed. In this case, the method used to detoxify castor seed involves fermentation. The seeds are first dehulled and boiled in water for about 18 hours. The boiled seeds are cooled and wrapped together with leaves and allowed to ferment in the fire place for about five days. The fermented seeds are then mashed by pounding using a mortar and pestle. This is followed by addition of ash from burnt palm kernel husk which gives it a dark colour. The dark, mashed product is allowed to mature for a further period of five days after which it is packaged for sale. It is believed that most of the detoxification takes place during fermentation and it leads to the elimination of the toxic factors. Microbiological studies have shown that the bacteria involved are spore-forming bacteria, especially members of the genus *Bacillus*

Detailed inputs on castor meal composition, its uses and demand-supply information are provided in this chapter.

Chapter 9 Castor Oil Distribution & Logistics

Castor oil is transported for long distances – sometimes tens of thousands of kilometers - from the place of production to the place of consumption. This transportation also takes different forms, the primary means being by road and by ship transportation. The extensive logistics required in the castor oil business implies that producers and consumers of castor oil and derivatives have in-depth knowledge of the key aspects in castor oil storage, transportation and logistics. This chapter provides these inputs.

Key Sections

SAMPLE TOPIC

Risk Factors & Loss Prevention

Contamination

Active behavior	Leaking oil leads to massive contamination and may make whole cargoes unusable. Of considerable significance with regard to tank cleaning is the iodine value, which is a measure of how strong a tendency the oil has to oxidation and thus to drying. Drying is particularly detrimental to tank cleaning, as the oil/fat sticks to the walls and can be removed only with difficulty. On the basis of drying capacity, oils are divided into nondrying, semidrying and drying oils. With an iodine value of 81 - 100, castor oil is a non-drying oil, which means that it does not dry significantly on contact with atmospheric oxygen and so the tanks are easily cleaned.
Passive behavior	Castor oil is sensitive to contamination by ferrous and rust particles and water (especially seawater). The tanks or barrels must be clean and in a thoroughly hygienic condition before filling.

More such risk factors and prevention methods are discussed in this chapter

Chapter 10 Prominent Castor Oil Producers

India is by far the largest producer and exporter of castor oil, followed by China and Brazil. However, many other countries – especially from South East Asia, Africa and South America - are showing significant interest in being large-scale producers of castor crop, castor oil and castor chemicals in future. This chapter provides profiles and details of the key companies involved in the castor oil industry, with a special focus on the leading Indian castor oil and castor oil derivative producers.

SAMPLE TOPIC

RPK Agrotech

Main Line of Business: Castor oil and derivatives producer and trader

Background: RPK Agrotech was established in 2004 and focuses on castor oil exports.

Products: The Company focused on producing the basic castor oil grades. The company has also started trading of castor oil derivatives mainly HCO and 12 HSA, which the company gets made on job work basis. The company has a capacity to crush over 9000 MT of castor seed per month. It is currently (Dec 2008) setting up new plant with crushing capacity of castor seed with 250 MT per day.

For a complete list of products, please see the following URL –
http://rpkagrotech.com/products.php

Financials: Approximately $25 million

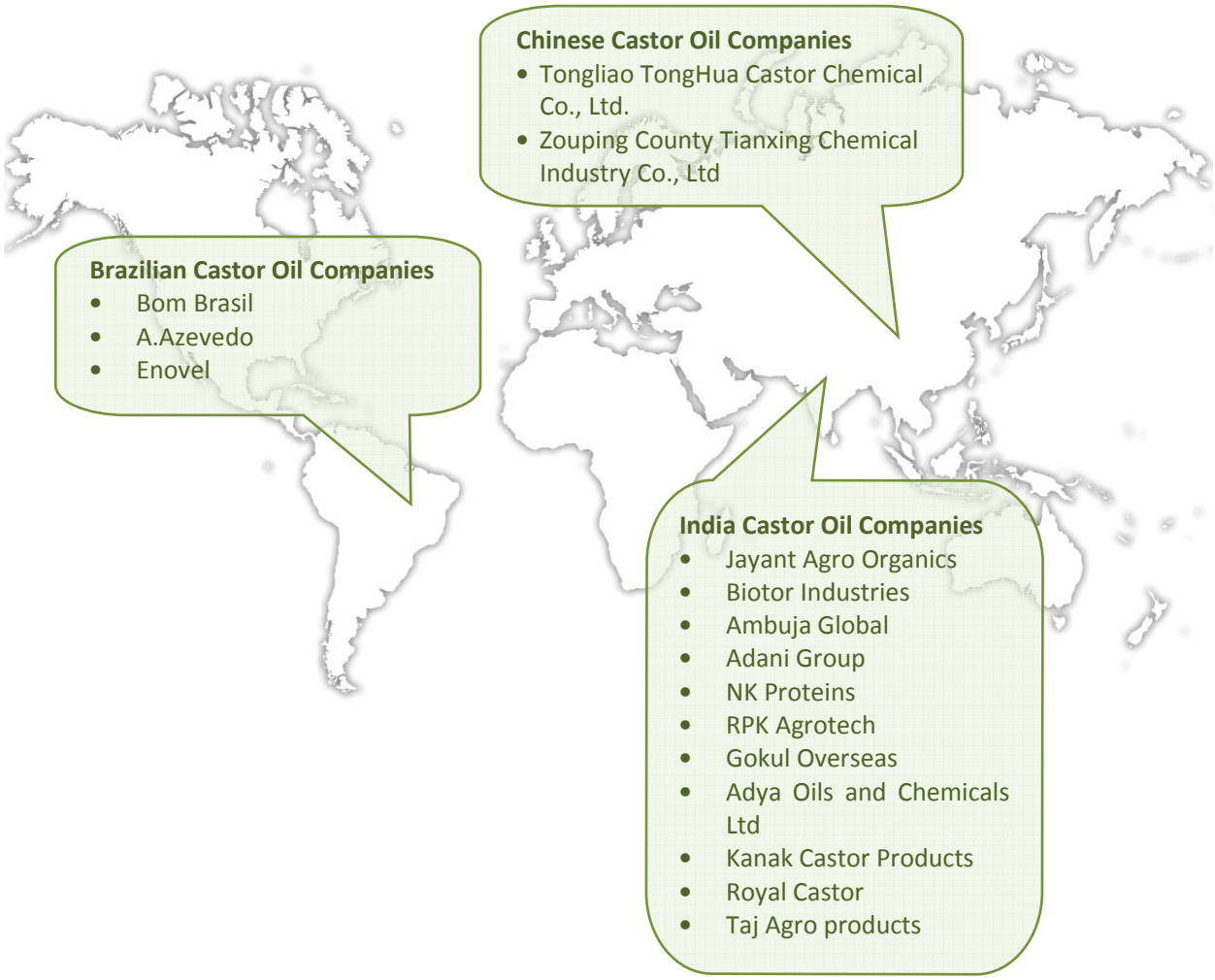
Location: The Company operates a manufacturing facility at KSEZ Kandla in the state of Gujarat. The other unit is at Bhachau, also in Gujarat.

Address:
Plot No 351, 2nd Floor,
Sector 1/A, Gandhidham,
Gujarat - 370201
www.rpkagrotech.com

Detailed profiles are provided for over 10 prominent companies from India, China and Brazil that have ventured into the castor oil industry.

List of Companies

India Castor Oil Companies
Chinese Castor Oil Companies
Brazilian Castor Oil Companies



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