

# Promoting Ginger Oleoresin Production in Nigeria for Economic Growth and Sustainable Supply to User Industries

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## Abstract

Nigeria ranks 2<sup>nd</sup> amongst top 10 ginger producers in the world with a production of 691,239 tonnes and its ginger is among the best, with its aroma, pungency and high oil and oleoresin content as distinct features. The most important form of ginger commercially is the dried form because it can be further processed in the industry to ginger powder, ginger oil and ginger oleoresin. There is an increasing international demand for ginger oleoresins, especially for the production of alcoholic beverages, ginger ale and gingerbread. The global ginger oil market is expected to grow at a CAGR of 9.41 % from 2020 to 2025 to reach a total market size of US\$189.431 million by 2025, increasing from US\$110.435 million. Nigeria, with the volume of ginger production and distinctive features of its ginger, should tap into this market demand. However, ginger is exported from Nigeria in the split-dried form while value-added products such as ginger powder, essential oils and oleoresin are imported at high cost. According to the Nigeria Customs Service data, 700,891 kg of resinoids and mixtures of odoriferous substances were imported to Nigeria from 2016 to 2019 at a value of ₦1.24 billion. To take advantage of the ever expanding global oleoresin market, formation of farmers clusters/cooperatives, development of farmers-processors linkages, quality assurance through Good Agricultural Practices, technology development, Public-Private Partnerships, development of Nigeria Industrial Standards (NIS) for oleoresins and import restrictions on ginger oleoresin are recommended. There is need for synergy amongst government agencies to harmonize and integrate various development plans and strategies for ginger value chain. Establishment of an institutional framework for proper coordination is also recommended to harmonize all the activities in the sector for greater impact.

**Keywords:** Ginger, value addition, oleoresin, resinoids, ginger oil, export, import

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## 1. Introduction

Oleoresins are semi-solid extracts, from spices and herbs, composed of resin and essential or fatty oil. Oleoresin is oil and resin that is a mixture of essential oils as an aroma carrier and a kind of resin as a carrier of flavour (Seema, et al., 2016; Susheela, 2000). They are naturally occurring mixture of essential oil and a resin extracted from various spices with organic solvents (Moyler, 1991). Oleoresins are characterised by high potency of active components which enables their usage in small dosages and they find applications in Beverages, Meat Canning, Confectionery, Sauces and Pharmaceuticals. They are also used as a base for a number of seasonings. Oleoresins are increasingly used in pharmaceutical applications owing to its antioxidant and anti-inflammatory properties. The type of solvent affects the quality and quantity of oleoresin obtained (Said et al., 2015).

Oleoresins can be produced from various plant sources and from different plant parts. The plants include basil, capsicum annum (paprika/pepper), cardamom, celery seed, cinnamon bark, clove bud, fenugreek, fir balsam, ginger, garlic, onion, mace, nutmeg, parsley, pepper (black/white), rosemary, sage, savory, thyme, turmeric, vanilla, bay leaves, etc. while plant parts include leaves, stems, bark, seeds, fruits, roots and plant exudates. Oleoresins can replace whole/ground spices without impairing any flavour and aroma characteristic (Burdock, 2010; UNIDO & FAO, 2005).

Oleoresins provide a number of advantages over traditional spices as flavouring agents. They represent the complete flavour and non-volatile resinous fraction present in the spices (Sharma Sharma, 2004). Important flavour compounds found in culinary herbs and other spice plants include eugenol from allspice, cinnamon, cassia, clove; piperine from black pepper; gingerol from ginger; myristicin from nutmeg; turmerone from turmeric and vanillin from vanilla (Peter, 2000). Oleoresins are 5–20 times stronger in flavour than their corresponding spices and they are commonly marketed as spice drops (Ravindran and Kallapurackal, 2012; Suderman, 2011). Oleoresin market by segment is shown in Table 1.

Table 1: Oleoresin Market by Segment

Source	By Raw Material	Application	Extraction Process	Region
Paprika	Leaves	Food & Beverages	Solvent Extraction	North America
Capsicum	Seeds	Pharmaceutical & Nutraceutical	Supercritical fluid extraction	Europe
Seed spices	Flowers	Flavours & Colour		Asia Pacific
Turmeric	Roots	Personal care products		Central & South America
Herbs	Stems	Feed		Middle East & Africa
Ginger	Bark	Others		
Cinnamon & Cassia	Fruits			
Herbs	Plant exudates			
Others (cardamom, floral, vanilla, tamarind, nutmeg, onion, and garlic)				

According to MarketsandMarkets (2019), the global oleoresins market is estimated to be valued at USD 1.2 billion in 2019 and is projected to reach USD 1.7 billion by 2025, recording a CAGR of 6.0% from 2019 to 2025. The rising trend of using natural flavors in processed food and an increasing number of quick service restaurants have led to a surge in demand for oleoresins. Among the different applications, the market is estimated to be dominated by the food & beverages segment from 2019 to 2025, owing to the wide usage of oleoresins that provide a natural flavor and fragrance in confectioneries and beverages.

## 2. Ginger and Oleoresin

### 2.1 Ginger rhizome

Ginger has a slightly biting and hot note; its aroma is rich, sweet, warm with a distinctive woody olfactory note. Nigeria is the third-largest producer of ginger in the world (after India and China). The estimated global production shares for the top three ginger producing countries in the world are 35 %, 18 % and 11.5 % for India, China and Nigeria respectively (OEC, 2019).

According to FAOSTAT, top ginger exporters in 2018 were China, Thailand, Netherlands, Peru and Nigeria. China had 55 % market share worth USD 525 million, Thailand with 8.9 % market share worth USD 83.8 million, Netherlands with 7.7 % market share worth USD 72.8 million, Peru with 4.95 % market share worth USD 46.6 million and Nigeria with 3.98 % market share worth USD 37.4 million. Also, top ginger importers in 2018 were the United States of America (USD 114 million), Pakistan (USD 107 million), Japan (USD 79.2 million) and Germany (USD 55.7 million) (OEC, 2019). Other major importing countries are the United Kingdom, Saudi Arabia, Singapore, Malaysia, Korea, the Netherlands, Canada and France.

Worldwide ginger production in 2019 reached 4 million tonnes with a planted area of 385,000 hectares. The Asia continent topped the chart with production of 3.2 million tonnes, followed by Africa with about 811,000 tonnes, America with 37,000 tonnes and Oceanic with about 9,000 tonnes (FAO, 2021). Global Ginger Market is expected to reach US\$ 8.46 Billion by the end of the year 2027 from US\$ 6.82 Billion in 2020, growing with a CAGR of 3.13% from 2021 to 2027 (Research and Markets, 2021). According to FAOSTAT (2021), Nigeria ranked 2<sup>nd</sup> amongst the top 10 ginger producers in the world with a production of 691,239 tonnes (Table 2).

Table 2: Top 10 Ginger producing countries in 2019

Rank	Country	Production (Tonnes)
1	India	1,788,000
2	Nigeria	691,239
3	China	581,137
4	Nepal	297,512
5	Indonesia	174,380
6	Thailand	166,923
7	Cameroon	83,434
8	Bangladesh	80,234
9	Japan	45,506
10	Philippines	26,929

Source: FAOSTAT, 2021

At the international market, ginger is presented in three major forms namely; fresh or green ginger,

preserved ginger and dried (split and whole). The most important form of ginger commercially is the dried one because it can be further processed in the industry to ginger powder, ginger oil and ginger oleoresin. For a good yield of oleoresin and ginger oil, ginger should be harvested at 7 – 8 months after planting (Kausha, et al., 2017). Ginger based products have wide range applications in many industries like food and beverage, pharmaceutical and cosmetics, confectionery, tobacco processing, etc. There is also increasing demand for ginger tea and ginger health drinks. Nigeria’s ginger is among the best in the world, with its aroma, pungency and high oil and oleoresin content as distinct features (Njoku et al., 1995). The main producing zone is Kaduna state, and to a lesser extent Nasarawa, Niger, Gombe, Bauchi, and Benue (Okafor, 2002).

## 2.2 Ginger Oleoresin

Ginger Oleoresin is a dark red-brown, viscous material with a natural, unique ginger aroma. Commercial ginger oleoresin usually has a volatile oil content of 25–30 % and replacement strength of 1 kg oleoresin for 28 kg good-quality ground spice (Vasala, 2012). There is an increasing international demand for ginger oleoresins, especially for the production of alcoholic beverages, ginger ale and gingerbread. It is also used in sweets, curry powders, soft drinks, sauces and it is in huge demand in the Ayurvedic, nutraceutical and pharmaceutical industries. The global ginger oil market is expected to grow at a CAGR of 9.41 % from 2020 to 2025 to reach a total market size of US\$189.431 million by 2025, increasing from US\$110.435 million (Research and Markets, 2020). Nigeria, with the volume of ginger production and distinctive features of its ginger, could tap into this global market demand.

However, the level of value addition to ginger in Nigeria is very low. Ginger is exported from Nigeria in the split-dried form while value-added products such as ginger powder, essential oils and oleoresin are imported at high cost. According to Nigeria Customs Service data, 700,891 kg of resinoids and mixtures of odoriferous substances were imported to Nigeria from 2016 to 2019 at a value of 1.24 billion Naira (Table 3).

Table 3: Resinoids and Mixtures of Odoriferous Substances Imports to Nigeria, 2016 – 2019

HS CODE	Description	2016		2017		2018		2019		Total (2016 – 2019)	
		Qty (kg)	Value (₦)	Qty (kg)	Value (₦)	Qty (kg)	Value (₦)	Qty (kg)	Value (₦)	Qty (kg)	Value (₦)
3301300000	Resinoids	17,848	6,051,641	4,787	11,316,475	2,575	7,499,690	2,607	8,131,327	27,816	32,999,133
3302100000	Mixtures of odoriferous substances of a kind	34,626	122,168,656	31,533	106,697,798	36,950	76,842,424	NA	NA	103,109	305,708,878
	Mixtures of odoriferous substances of a kind used in the food or drink industries	NA	NA	NA	NA	32,862	104,525,699	91,011	110,968,553	123,872	215,494,251
	Mixtures of or with basis of odoriferous	37,808	28,728,052	29,537	99,805,227	140,318	46,282,046	NA	NA	207,664	174,815,324
3302901000	Mixtures of odoriferous substances of a kind	14,980	19,544,767	9,529	15,837,497	12,192	18,499,578	NA	NA	36,701	53,881,842
	Mixtures of odoriferous substances of a kind used in perfumery	NA	NA	NA	NA	6,505	12,654,358	15,654	15,741,099	22,158	28,395,457
	Mixtures of or with a basis of odoriferous	40,445	28,642,249	16,191	71,491,715	16,920	5,044,968	NA	NA	73,556	105,178,932
3302909000	Mixtures of odoriferous substances of a kind	19,584	44,050,093	10,554	38,945,828	12,950	42,747,659	NA	NA	43,089	125,743,581
	Mixtures of odoriferous substances of a kind used in other industries	NA	NA	NA	NA	8,176	31,722,025	9,389	45,024,044	17,565	76,746,069
	Mixtures of or with a basis of odoriferous	14,161	41,027,445	13,127	33,774,174	18,072	49,484,930	NA	NA	45,360	124,286,548
	<b>Grand Total</b>	<b>179,454</b>	<b>290,212,903</b>	<b>115,257</b>	<b>377,868,714</b>	<b>287,520</b>	<b>395,303,376</b>	<b>118,660</b>	<b>179,865,023</b>	<b>700,891</b>	<b>1,243,250,015</b>

Source: Nigeria Customs Service, 2020

Import volume and value of Resinoids and Mixtures of odoriferous substances by year are shown in Figures 1 and 2 respectively. The highest volume of 287,520 kg worth over ₦395.303 million was recorded in 2018. The lowest volume of 115,257 kg in 2017 was worth over ₦377.869 million, import volume peaked in 2018 before dropping to 118,600 kg in 2019 at the cost of over ₦179.865 million.

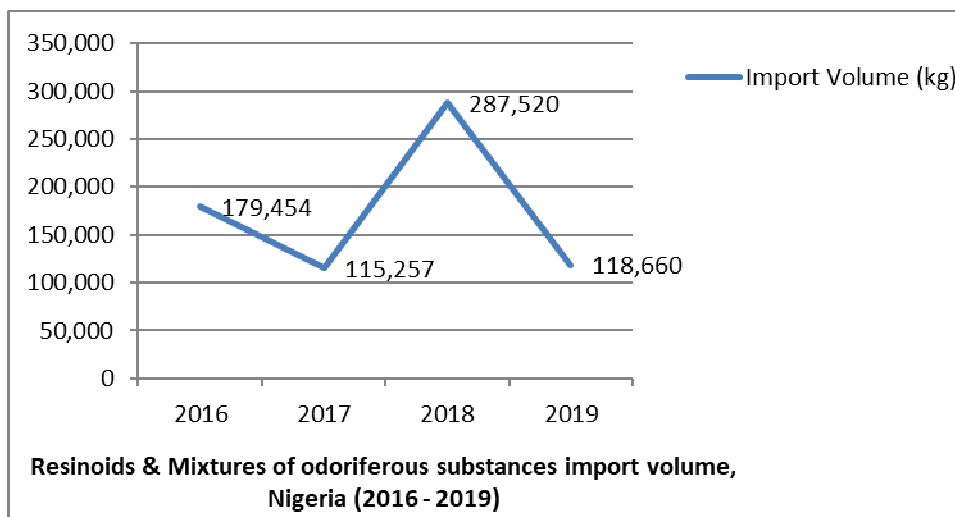


Figure 1: Resinoids and Mixtures of odoriferous substances import volume, Nigeria (2016 - 2019)

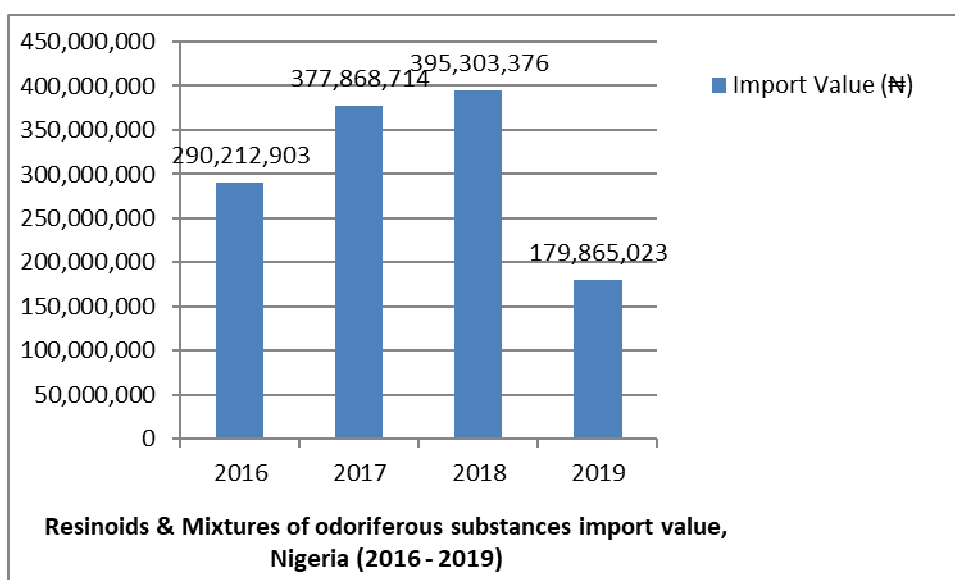


Figure 2: Resinoids and Mixtures of odoriferous substances import value, Nigeria (2016 - 2019)

### 3. RMRDC’s INITIATIVES ON GINGER VALUE CHAIN DEVELOPMENT IN NIGERIA

Recognizing the economic potentials of ginger and the need to position ginger as one of the key economic crops in Nigeria, the Raw Materials Research and Development Council (RMRDC) organized a Stakeholders’ Forum on Ginger Value Chain Development in Nigeria geared towards bringing together key players in the ginger value chain to brainstorm on the status, challenges, options, opportunities and policy requirements in the sector.

The Council identified and collaborated with Belphins Nigeria Ltd, Kafanchan, Kaduna State and Tiger Foods Ltd, Onitsha, Anambra State on production of ginger oleoresin and ginger value-added products respectively. In the course of collaborations, physico-chemical analysis and microbiological examinations were carried out on samples of oleoresin produced by Belphins Nigeria Ltd at the Institute of Public Analysts of Nigeria (IPAN) and the National Agency for Food and Drug Administration and Control (NAFDAC) using the methods of Association of Official Analytical Chemists (AOAC). Figure 3 shows samples of ginger oleoresin produced by Belphins Nigeria Ltd, Kafanchan, Kaduna State.



Figure 3: Samples of Ginger Oleoresin  
 Courtesy: Belphins Nigeria Ltd, Kaduna

The outcome of the analyses (Tables 4 and 5) formed the basis for a roundtable/advocacy meeting with the Organised Private Sector (OPS) for the utilisation of made-in-Nigeria ginger oleoresin by Nigeria's industries.

Table 4: Physico-Chemical Analysis and Microbiological Examinations of Ginger Oleoresin Sample 1

<b>Physico-Chemical Analysis</b>	<b>Results</b>	<b>Limits</b>
General Description (Appearance)	Dark-brown viscous oil	NA
Odour	Nil	NA
Relative density at 20°C	1.055	NA
Volatile matter 105°C (%)	13.62	NA
Saponification value	87.69	NA
Acid value (mg KOH/g)	26.67	NA
Iodine value	37.01	NA
Mineral oil	-	NA
Free fatty acid (as oleic) %	13.27	NA
Ash (%)	-	NA
<b>Microbiological Exams</b>		
Total Aerobic Mesophilic Count (cfu/g)	Nil	1000 max
Total Coliform	Nil	10 max
Yeast/Moulds (cfu/g)	Nil	100 max
<i>E. coli</i>	Absent	0g, 0 (cfu/g)
<i>Salmonella spp</i>	Absent	
<b>Pesticide Residues (ppb)</b>	Not detected	

Table 5: Physico-Chemical Analysis and Microbiological Examinations of Ginger Oleoresin Sample 2

Physico-Chemical Analysis	Results	Expected
General Description (Appearance)	Black viscous liquid	NA
Odour	Unobjectionable	NA
Relative density at 20°C	-	NA
Volatile matter 105°C (%)	10.65	NA
Saponification value	-	NA
Acid value (mg KOH/g)	7.57	NA
Iodine value	-	NA
Mineral oil	Negative	NA
Free fatty acid (as oleic) %	-	NA
Ash (%)	4.74	NA
<b>Vitamins (mg/l)</b>		Recommended daily dose (RDM)
B <sub>3</sub> (Niacin)	Not detected	13–17mg
B <sub>2</sub> (Riboflavin)	1.3	1.2-1.6mg
B <sub>1</sub> (Thiamin)	6.5	1.0-1.5mg
B <sub>6</sub> (Pyridoxine)	0.2	1.2–1.8mg
B <sub>12</sub> (Cobalamin)	5.5	3µg
C	Not detected	
<b>Trace Elements/Minerals (ppm)</b>		
Arsenic	0.231	Tolerable dietary intake 130µg/day (max)
Cadmium	0.016	Permissible level 0.1mg/kg
Chromium	0.035	25 - 35µg
Mercury	0.085	Tolerable weekly intake/ safe level 4µg/kg body weight
Manganese	0.001	Recommended daily allowance (RDA) 1.8 – 2.3mg
Iron	0.02	RDA 40 – 45 mg
Lead	0.012	0.3mg/kg max
<b>Microbiological Exams</b>		
Total Aerobic Mesophilic Count (cfu/g)	<1x10 <sup>3</sup>	1000 max
Total Coliform	Nil	10 max
Yeast/Moulds (cfu/g)	1.0x10 <sup>1</sup>	100 max
<i>E. coli</i>	0	0g, 0 (cfu/g)
<i>Salmonella spp</i>	-	

Also, ginger splitting machine and ginger drying equipment were designed and developed in collaboration with the National Root Crops Research Institute (NRCRI), Umudike, Abia State and Farm Industries, Owerri, Imo State. The machines were deployed to Ginger Growers Association in Mbaitoli Local Government Area of Imo State for commercial ginger processing.

Improved varieties of ginger rhizomes (UG2) have been distributed to Ginger Farmers Association in selected States of Nigeria to promote cultivation and increase yield.

#### 4. CONCLUSION AND RECOMMENDATIONS

##### 4.1 Recommendations

The demand for ginger oleoresin in Nigeria is on the rise from both food and Pharmaceutical industries but current demand is not being met locally, leading to import dependence. Nigeria's ginger is among the best in the world, with its aroma, pungency and high oil and oleoresin content as distinct features. Therefore, the country has huge potentials for oleoresin production and marketing. To take advantage of the ever expanding global oleoresin market, the following strategies are recommended.

- **Formation of Clusters/Cooperatives:** Farmers should be encouraged to form clusters/cooperatives for easier access to funds, improved crops varieties and other farm inputs from the government and development agencies.

- **Farmers-Processors Linkages:** There should be linkages between farmers and processors for the off-take of the commodity at agreed price to mitigate harvest risk. The overall goal is to get more farmers involved in the cultivation of ginger for sustainable supply of raw materials to existing and emerging oleoresin extraction plants.
- **Quality Assurance:** Farmers should be trained on ginger Good Agricultural Practices (GAP) to guarantee quality commodity for processing.
- **Technology Development:** Existing technologies for small scale oleoresin extraction should be adopted and copied through reverse engineering.
- **Public-Private Partnerships:** Business linkages between public and private sectors for the establishment of small scale oleoresin extraction plants across the country should be facilitated and developed by agencies like RMRDC and NRCRI.
- **Standards:** Nigeria Industrial Standards (NIS) for oleoresins should be developed by the Standards Organization of Nigeria (SON) in collaboration with other stakeholders to build user industry's trust.
- **Tariff:** Oleoresin import should be discouraged through tariff and other measures to encourage local production.

#### 4.2 Conclusion

The global Ginger Oleoresin market is anticipated to rise at a considerable rate between 2021 and 2026. Despite the fact that Nigeria has competitive advantage in the production of ginger for oleoresin extraction, the country still depends on importation of oleoresin for industrial use. Therefore, there is need for synergy amongst government agencies to harmonize and integrate various development plans and strategies for the growth of the sector. An institutional framework should be established for proper coordination. Also, the right incentives for investment in the oleoresin sector should be created while the existing ones should be implemented judiciously to attract investors to the sector. The production of ginger oleoresin in Nigeria would undoubtedly create more value for the commodity in the industry and enhance its economic potentials.

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