सत्यमेव जयते

MINISTRY OF FOOD PROCESSING INDUSTRIES
GOVERNMENT OF INDIA

NIFTEM
KNOWLEDGE • INNOVATION • OUTREACH

LENTILS
Production Technology

AATMANIRBHAR BHARAT

Pm Formalisation Of Micro Food Processing Enterprise Scheme(PM FME Scheme)

INTRODUCTION

- Lentil or masoor (*Lens culnaris Mediu*.) is one of the oldest food crops.
- Lentil is a valuable human food
- Mostly it is consumed as a dry seed (whole decorticated and split).
- It is an annual plant known for its lens-shaped seeds
- It is about 40 cm (16 in) tall
- the seeds grow in pods, usually with two seeds in each
- In cuisines of the Indian subcontinent, where lentils are a staple food
- It is also ground into flour to make variety of preparation.

- Split lentils (often with their hulls removed) known as daal are often cooked into a thick curry/gravy that is usually eaten with rice or rotis.
- In India, it is commonly consumed as dal (seed boiled and meshed in to soup).
- It is also used in preparation of several snakes and sweets. The straw and pod walls have high feed value.
- De-hulled lentil seed contain 24-26% protein, 1.3 % fat, 2.2 % ash, 3.2 and fibre and 57% carbohydrate.
- It is a rich source of calcium (68 mg/100g seed). It is also rich in vitamins C and riboflavin.
- Lentils are relatively quick and easy to prepare, and their low cost makes them an accessible form of high quality protein for many people around the world.

TAXONOMY

- As per Joshi et al., (2017) its taxonomic description is as follows:
- Kingdom- Plantae
- Subkingdom- Angiosperm
- Division- Eudicots
- Subclass- Rosids
- Order- Fabales
- Family- Fabaceae
- Sub-family- Faboideae
- Tribe- Vicieae
- Genus- *Lens*
- Species- *culinaris*

NUTRITIONAL VALUE OF LENTIL PER 100 G DRY WEIGHT

Sr. No.	Nutrient	Whole Lentils	Split Lentils
1.	Energy	1,477 kJ	1443.5 kJ
2.	Carbohydrates	60 g	59.2 g
3.	Sugars, total	2 g	-
4.	Dietary fiber	30.5 g	10.8 g
5.	Fat	1.1 g	2.2 g
6.	Protein	25.8 g	25 g
Vitamins			
7.	Vitamin A	39 IU	58 IU
8.	Thiamine (B1)	0.9 mg	0.5 mg
9.	Riboflavin (B2)	0.2 mg	0.1 mg
10.	Niacin (B3)	2.6 mg	1.5 mg
11.	Pantothenic acid (B5)	2.1 mg	0.3 mg
12.	Vitamin B6	0.5 mg	0.4 mg
13.	Folate (B9)	479 µg	204 µg
14.	Vitamin C	4.4 mg	1.7 mg
Minerals			
15.	Calcium	56 mg	41 mg
16.	Iron	7.54 mg	7.6 mg
17.	Magnesium	122 mg	72 mg
18.	Phosphorus	451 mg	294 mg
19.	Potassium	955 mg	578 mg
20.	Sodium	6 mg	7 mg
21.	Zinc	4.78 mg	3.9 mg
Other constituents			
22.	Water	10.4 g	11.8 g

RECOMMENDED VARIETIES OF LENTIL (STATE-WISE)

Sr. No.	State	Small seeded	Bold seeded
1	Jammu and Kashmir	Pant L 406, Pant L 639	-
2	Himachal Pradesh	Pant L 406, Pant L 639	Vipasha
3	NEH	Pant L 406, Pant L 639	
4	Punjab	LL 56, LL 147, Pant L 4, Vaibhav	L 4076, Sapna, Priya, Sheri
5	Haryana	Pant L 4, Vaibhav	L 4076, Sapna, Garima, Priya, Sheri
6	Delhi	Pant L 4, Vaibhav	L 4076, Sapna, Priya, Sheli
7	Uttaranchal	VL Masoor 1, VL Masoor 4	
8	Uttar Pradesh (West)	Pant L 4, Vaibhav	L 4076, Sapna, Priya, Sheri
9	Uttar Pradesh (East)	Pant L 406, Pant L 639	Malika
10	Uttar Pradesh (Bundelkhand)	-	Malika, L 4076, JL 3, Noori
11	Bihar and Jharkhand	Pant L 406, Pant L639, Arun	Malika
12	West Bengal	Pant L 406, Pant L 639, Ranjan	Malika, Subrata
13	Madhya Pradesh and Chhattisgarh	-	JL 1, Malika, L 4076, Jawahar Masoor 3, Noori
14	Maharashtra	-	Malika, L 4076, Noori, Jawahar Masoor 3
15	Rajasthan	-	Malika, L 4076, Jawahar Masoor 3, Noori

DISEASE RESISTANT/ TOLERANT VARIETIES

Sr. No.	Disease	Varieties
1.	Rust	Pant L 406, Pant L 639, Pant L 4, L 4076, Sapna, Priya, Sheri, IPL 81, Vaibhav, LL 56, LL 147
2.	Wilt	Pant L 406, Pant L 639, Pant L 4, L 4076, Priya, Sheri, Jawahar Masoor 3, Vaibhav, IPL 81

PRODUCTION & MARKET POTENTIAL

- The majority of world production comes from canada and india, producing 58% combined of the world total.
- Favourable climatic conditions helped for a good crop this year 2020.
- India hopes to see close to 28 per cent growth in production of red lentils (or masoor dal) at about 1.6 million tons in 2020-21.
- The production of red lentils has been about 1.25 million tons in the last four to five years.
- The average annual global lentil production was estimated to be 4.457 million metric tons between 2009 and 2013.
- It is projected that the total consumption of red lentils in india is close to 1.9-2 million tonnes.

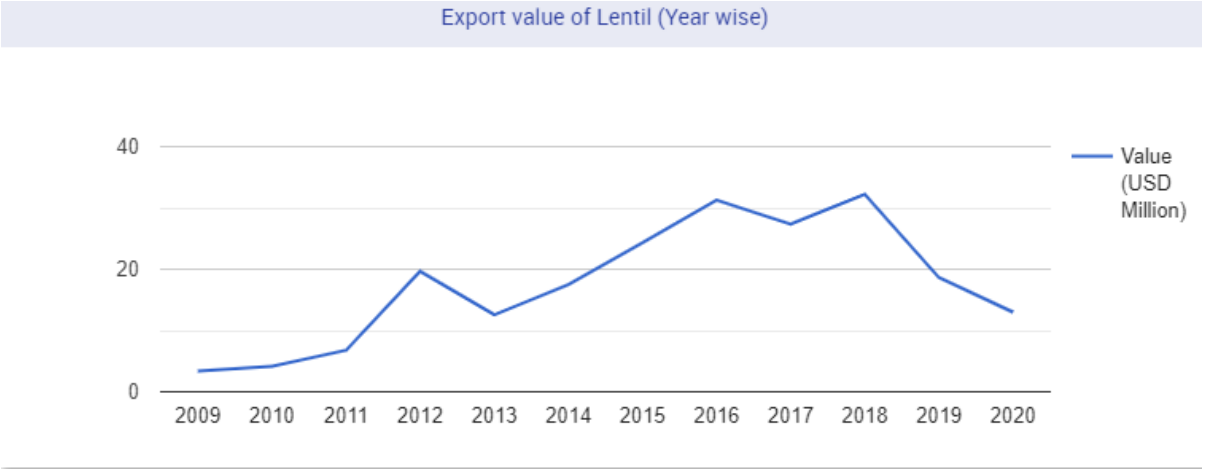
- West Bengal, Bihar and some of the northeastern states of Tripura, Nagaland, Assam and Manipur are the key consumer states.
- India ranked first in terms of land and second in terms of production,
- With 39.79 per cent and 22.79 per cent of world area and production respectively (FAOSTAT statistics, 2014).
- The Lentil region of the country was 14,79 lakh hectares with a production of 10,38 lakh tonnes.
- Madhya Pradesh ranks Is in acreage i.e. 39.56 per cent (5.85 lakh ha)
- followed by UP (34.36 per cent) and Bihar (12.40 percent).

- UP ranks first with 36.65 percent (3.80 lakh tonnes) in terms of production,
- followed by Madhya Pradesh (28.82 percent) and Bihar (18.49 percent).
- Lentils are known to be among the good sources of prebiotics
- produce nutritionally significant amounts of prebiotic carbohydrates, including oligosaccharides (RFO), sugar alcohols, fructo-oligosaccharides (FOS) and resistant starch (RS) carbohydrates.
- Total prebiotic carbohydrate concentrations of lentils suggest that a 100 g portion of lentils may provide more than 13 g (12.3 g-14.1 g) of prebiotics,
- stressing the role of lentils as the leading source of these prebiotic carbohydrates

EXPORTING STATUS

- Lentil is export around the world from India.
- The data given for the export study indicates that approximately 90 countries and territories are actively importing Lentil from India.
- In FY 2020-2021 (Apr-Nov), Around 7.6 USD million value of Lentil was exported from India to Bangladesh. It was around 58.55% of the total export of Lentil.
- The combined value of total export is 12.98 USD million in the year of 2020
- Top 5 countries which are export from India are Bangladesh,USA,Bhutan, Qatar, Nepal
- The value of Lentil exported from India in October 2020 was 1.25 USD million .
- India exported Lentil to 81 countries with a total amount of USD 17.51 million back in 2014, which changed to 91 countries in 2015 and 103 countries in 2018.

Source: Connect2India.com



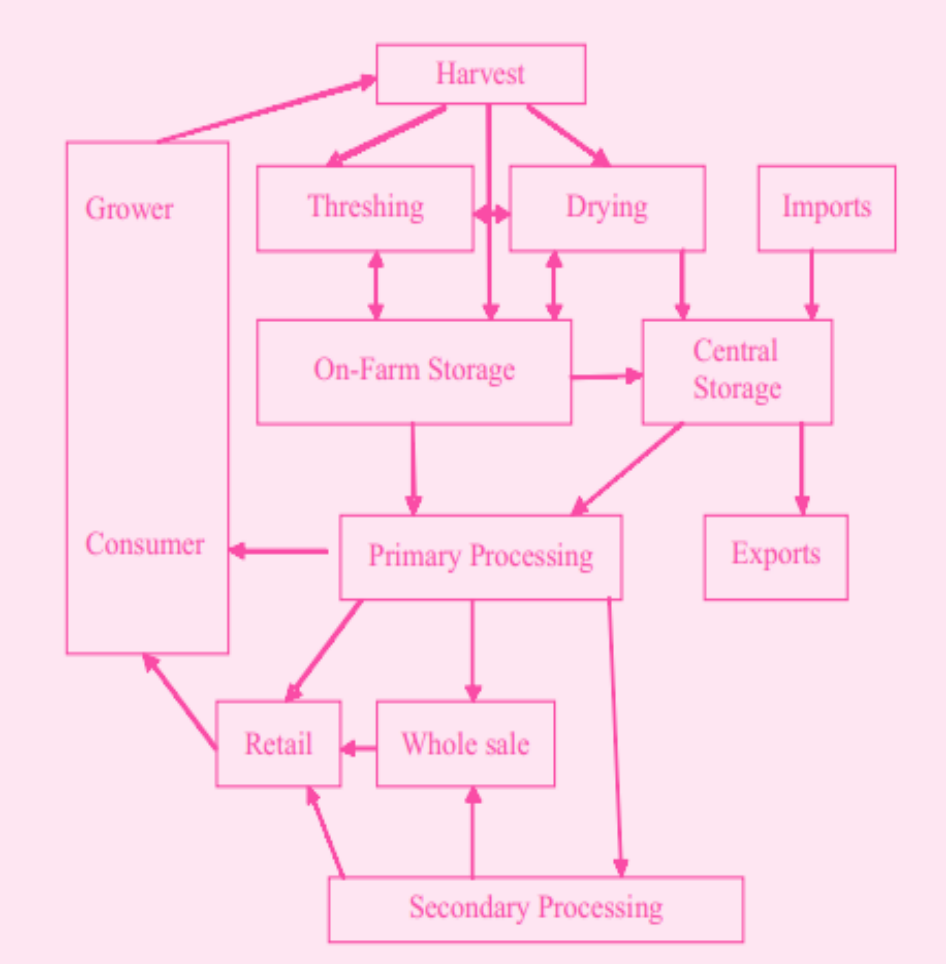
Lentil export trends (Year wise)

Year	Value (USD Million)
2009	3.35
2010	4.16
2011	6.79
2012	19.65
2013	12.57
2014	17.51
2015	24.34
2016	31.28
2017	27.34
2018	32.25
2019	18.66
2020	12.98

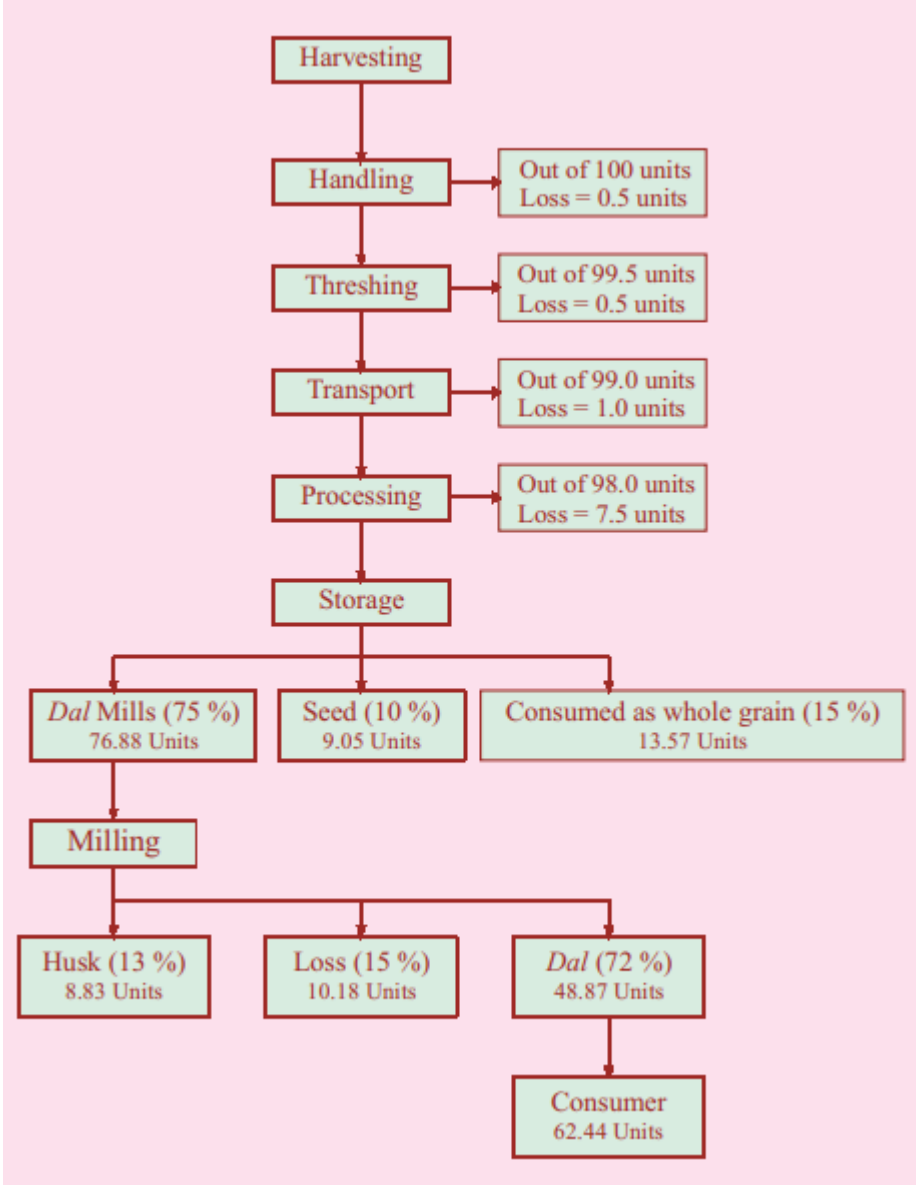
Source: Connect2India.com

POST-HARVEST MANAGEMENT

- Crop is ready for harvest when leaves begin to fall, stem and pod turn brown or straw in color and the seeds are hard and scrape with 15% moisture inside.
- Over-ripening can lead to a drop in pods as well as shattering and cracking of seeds.
- The moisture content of the seed falls below 10% due to delays in harvesting.
- The crop should be allowed to dry on the threshing floor for 4-7 days and threshed manually or by a bullock/power-drawn thresher.
- Clean seeds should be sun-dried for 3-4 days, taking their moisture content to 9-10 per cent.
- The seed should be stored safely in suitable bins and fumigated to protect it from bruchids **.**



Post-harvest system of Lentils



Post harvest profile of Pulses

POST HARVEST LOSES

- Post-harvest losses means a quantitative and qualitative loss
- Occurred in a given commodity during the different phases of the post-harvest method.
- Seeds of poor quality, improper farming practices and insect infestation in the field can cause loss of output even before harvesting.
- From harvest onwards, the grain undergoes a series of operations during which quantitative and qualitative losses may occur.
- A late harvest, for example, can bring about losses from attacks by birds and other pests.
- Insufficient drying of grain can cause losses from the development of moulds and insects.
- Threshing can cause losses from broken grains and encourage the development of insects.

- Poor storage conditions can bring about losses caused by the combined action of moulds, insects, rodents and other pests.
- Transport conditions or defective packaging of grain can lead to quantitative losses of product

Sr. No.	Stage of operation	Type of loss
1.	Late harvest	Shattering losses, losses due to attack of birds and other pests
2.	Insufficient drying of grain	Losses due to development of moulds and insects
3.	Improper threshing	Broken grains and threat of insect development at a later stage
4.	Poor storage	Losses caused by combined action of insects, moulds, rodents and other pests
5.	Improper milling	Broken and powdering loss
6.	Transport	Quantitative loss
7.	Defective packaging	Quantitative and qualitative loss

POST HARVEST OPERATIONS

- Various technologies for post-harvesting lentil operations are used.
- Traditional or modified methods used in different phases of the post-harvest scheme.

Sr. No.	Post-harvest operations	Traditional technologies	Improved technologies
1.	Harvest	Manual	Manual and mechanized
2.	Pre-drying	Standing or in shocks	Standing or in shocks
3.	Storage of harvested crops	In fields or on threshing floor	In fields or on threshing floor
4.	Threshing	Manual	Mechanized
5.	Pre-cleaning	Hand winnowing	Mechanized
6.	Drying	Natural	Artificial
7.	Cleaning and sorting	Winnowing in the wind	Mechanized
8.	Storage of grains	In traditional granaries	In bags or in bulk
9.	Processing/Milling	Manual	Mechanized

Harvesting

- Harvest is the method by which the usable portion or sections of the plant are gathered and
- It is carried out at the time of development of all the nutrients and the sufficient maturity of the edible parts.
- Harvesting takes place 10 to 15 days after the grain has attained physiological maturity.
- Lentil harvesting should take place at a time when the grain has moisture content in the range of 15-20.
- Harvesting take place when the upper leaves of the plant are dry, while the pods turn pale yellow.
- The plants are pulled up and allowed to pre-dry in the sun in order to harvest the pulse crops by hand. This procedure should be conducted early in the morning.

PRE-DRYING:

- This is the stage of the post-harvest phase during which the processed commodity is dried in order to undergo the next threshing process.
- The cut parts of the plant may contain too much green plant matter at the time of harvesting, and all the grains may not have attained a consistent degree of maturity and may be too high in moisture content. This makes pre-drying essential.
- Pre-drying can be done in two ways
  - Once maturity has been reached, allow the crops to stand in the field before harvesting for pre drying.
  - Place the stacks of freshly harvested crops in the field or on the dry ground.

THRESHING

- Threshing" is the method of separating the grains from the plants.
- These activities can be carried out by hand, or with the aid of animals or machines.

Sr. No.	Threshers	Technical details	Capacity (kg/h)
1.	Sonalika	25 hp tractor, Peg type, Single blower	300-350
2.	CIAE	7 hp motor, Peg type, Double blower	300-450

DRYING

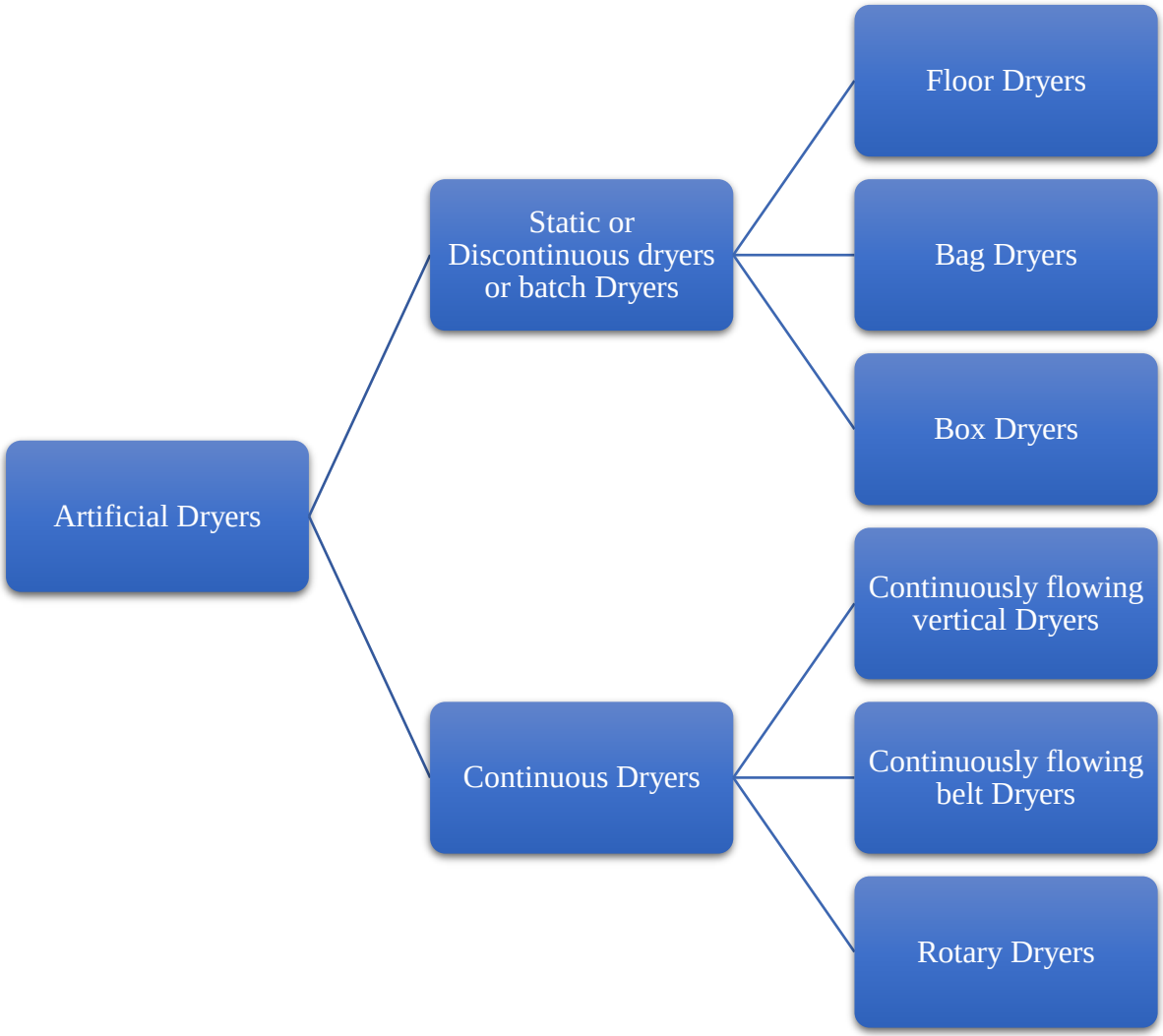
- After threshing, the moisture content of grains remains higher than the desired for safe grain storage (13-14 percent).
- Drying is a process of the post-harvest method during which the product is dried quickly until it meets the safe-moisture level.
- The purpose of the drying process is to reduce the moisture content of the grain for safe storage and further processing.

Essentially two methods are used for drying grain

1.Natural drying: the grain is spread over the drying floor in thin layers where it is exposed to air. Period can vary based on the moisture content required for safe storage.

2.Artificial drying: Here, heated air (dryers) or unheated air (dehumidifiers) is blown through a grain mass.

TYPE OF DRYERS



STORAGE

- It is the process of the post-harvest method during which the goods are kept in such a way as to guarantee food security other than during the time of agricultural production.

Important points to be considered while storage

1.The best way to maximize the shelf life of stored grain is to lower the temperature of the storage room.

2.The temperature of the storage area should be lower than 25^0C relative humidity should be 15% or below for the purpose of seed storage.

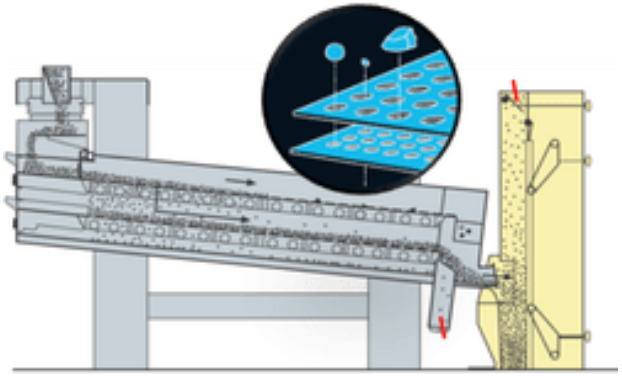
3.For a 1% decrease in moisture content, grain storage life is doubled when grain moisture content is between 5 and 14 %.

4.For every 5^0C reduction in storage temperature, the storage life of the grain is doubled when the temperature is between 0 and 50^0C.

CLEANING METHODS

SCREEN CLEANER AND ASPIRATOR

- The cleaning process usually starts with a screen cleaner and aspirator.
- Its done to take out coarse and fine impurities as well as dust.
- Screen cleaners are available in different types and sizes.
- Usually consist of flat sieves with slotted or round holes to separate fine and coarse impurities based on size.



DE STONER

- Its done to remove high density impurities such as stones, pieces of metal and glass.
- In a de-stoner, the product will be spread over a perforated deck
- The air passing through the perforated surface will create an air cushion on which the pulses will float slowly towards the machine outlet by gravity
- Heavy particles (i.e. stones) will sink to the bottom of the stream and pushed upward by the vibratory action of the deck.
- Stones will be discharged from the upper side of the machine

Sorting and grading

- Sorting and/or screening (dry and wet) are/is the separation of raw materials and/or food slurries
- Sorting of pulses could be based on size, density and color amongst other criteria.
- Optical sorters are widely used to ensure uniform color of pulse.
- For size sorting, various types of screens and sieves, with fixed or variable apertures, can be used. The screens may be stationary, rotating or vibrating
- Gravity tables are typically used to grade pulses based on density

METAL DETECTOR

- Metal detectors for food primarily are used for the purpose of consumer protection.
- Despite maximum care metallic contaminations of food products during the production process cannot be fully excluded.
- Metal particles that enter the product during the production process or already are contained in the raw material may cause serious injuries of consumers.
- Metal detectors for food provide effective protection against ferrous and non-ferrous metals (aluminium, stainless steel, etc.).

PRODUCTS OF LENTIL

1.WHOLE LENTIL

- Whole lentil can be primarily processed, packaged and marketed.
- Lentils are low in sodium and saturated fat, and high in potassium, fiber, folate, and plant chemicals called polyphenols that have antioxidant activity.
- Contain slow-digesting resistant starch that delays the absorption of carbohydrates with blood sugar-lowering effects.
- A source of prebiotics that feeds gut flora to help prevent digestive diseases.

PROCESSING

To achieve packaged whole lentil the under given steps are to be followed

A. Cleaning

- The cleaning process requires fixed and mobile cleaning machines, depending on various concepts.
- In order to obtain the export of a commodity containing not more than 3% of foreign matter in pulses,
- Dry cleaning process; coarse separation, fine separation, magnetic separation, peeling and stone separation are added to pulses.
- In the case of coarse separation, usually rough sieves, vacuum cleaners (aspirator sieve, duo vacuum cleaners, classification vacuum cleaners), cylindrical sieves, scalpers (drum, vibro, circular) and selectors are used.
- Re-cleaned in fine separators. Silo aspirator purifiers, mill aspirator purifiers and triières are used in fine separation.
- Magnetic separation happens as the metal parts within the pulses are taken up by the magnets.

Magnetic separator

Des-toner

Automatic pulse cleaning machine

Soaking and washing machines

B. CALIBRATION

- The cleaned product is subject to a calibration process.
- The calibration process is conducted by screening machines.
- The aim of the calibration is to obtain uniform groups by lowering foreign materials to the required level and by improving and classifying the quality for commercial purposes.
- Calibration is often carried out in order to achieve a homogeneous structure and to standardize the product.

C. SORTING:

- The pulses passing through the calibration process are exposed to color sorting and hand sorting.
- In a color-based sorting process, the main aim of sorting is to distinguish the colored grains in the unit.
- In this way, a computer-based color sorting system is used and is especially used in the production diagrams.
- Items from the sorting machine are subject to hand sorting. Manual sorting is carried out by selectors on both sides of a selection band of lengths ranging from 5 to 7 meters in order to select foreign matter and damaged particles under hygienic conditions.
- Defective product separation channels occur in the selection bands. The bands typically have a stainless steel body.

D. PACKAGING

- Cellophane, polyethylene (PE) carton packets, polyethylene bags are used as packaging for the protection of pulses from moisture and insects.
- In addition to this, it has recently become widespread as a paper/PE/foil/PE spectacle packaging material.
- In general, volumetric full automatic filling system and vertical form packing machines are used for the packaging of pulses.
- The packets are passed through metal detectors for any possible metallic impurities. The shelf life of the pulses, which were cleaned, calibrated, sorted, packed and served, is as long as two years.

Packaging machine

Metal detector

2. SPLIT LENTIL PULSE

- Whole lentil can be de-husked, decorticated, split and polished to achieve split lentil pulse which can be packaged and marketed
- The cooking time for split lentils is less than whole lentils because they already have the seed coat removed and have been split in half

PROCESSING

a. After cleaning, calibration and sorting operations as mentioned above, some operations are carried out, such as dehusking, drying, splitting and polishing.

Soaking and Washing machine

Magnetic separator

Destoner

Automatic pulse cleaning machine

B). DEHUSKING

- Usually, carborundum/emeric coated rollers are used for dehusking of different pulses.
- Cylindrical or taper rollers are used for this purpose.
- Rollers are available in various sizes based on power requirements, capacity, roller size and speed. Oil/Water applications are conducted on pitted pulses.
- Screw conveyors with full or cut screw are used as the screw slowly moves the grain along with the oil/water application at the conveyor entry.

C. DRYING

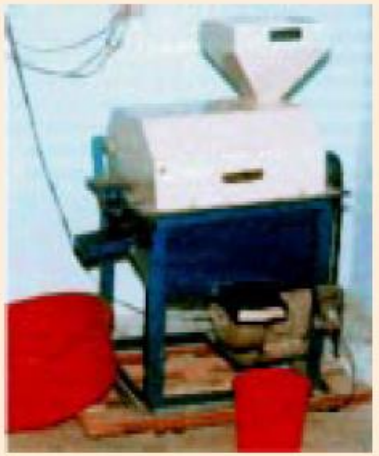
- Sun drying has traditionally used, but because it is a based operation, many dryers are used for this purpose.
- Drying is done to reduce moisture content to desired level.

Rotatory drum drier

Tray drier

D. SPLITTING

- Roller mills, under runner disk sheller, attrition mill (chakki), elevator and hard surface and impact sheller are used to split the dehusked pulses



CIAE Mini Dal Mill

PKV Mini Dal *Mill*

IIPR Dal Chakki

IIPR Mini Dal Mill

CFTRI Mini Dal Mill

PANTNAGAR Mini Dal Mill

E. POLISHING

- It denotes the removal of powder from dehusked splits and the use of oil and water to make the split lentil shine and luster.
- Cylindrical hard rubber roll, leather belts or emery cone polishers are used for this purpose.
- Rollers fitted with brushes can also be used to give the lentil shine.

F). POWDER AND HUSK SEPARATION:

- Husk and powder is separated from the dehusked and polished split pulses by using suction fan or blower.

G)PACKAGING:

- Similar as given for whole lentils

Packaging machine

Metal detector


Large &Small Impurities
Stones
Vibrating Screen
Gravity Destoner
Two Round of Peeling
Clean Lentil
Magnetic Separator
Grader
Splitting Machine
Grader
Lentil Flour
Grinder
Broken Lentils
Packaging
Peeled &Split Lentil
Color Sorter
Polishing

3. FRIED CRISPY WHOLE LENTIL*:*

- Fried crispy whole lentil or masoor dal namkeen recipe is a crisp and delicious tea-time snack. Masoor dal namkeen is a popular snack in North India and can be prepared with minimal ingredients.

Raw material:

- Whole lentil (wash and soak for 9-10 hour) – 250 gm
- Salt– 10 gm
- Black Pepper Powder – 5 gm
- Red Chili Powder – 5 gm
- Dry Mango Powder – 5 gm
- Oil for frying – Sunflower oil

PROCESSING

- Clean and sort whole lentils for any physical impurities.
- Soak lentils for 4 to 5 hours in 3 times of water.
- Remove all water from the whole lentil and keep it on a cotton cloth for 15 to 20 minutes.
- Heat the oil in pan on high flame, put lentil in hot oil.
- Fry it until lentil becomes crispy.
- Take out the lentil and keep in a strainer.
- Add the salt, black pepper powder, red chili powder and dry mango powder, mix well.
- Allow to cool and pack.

Soaking

Fryer

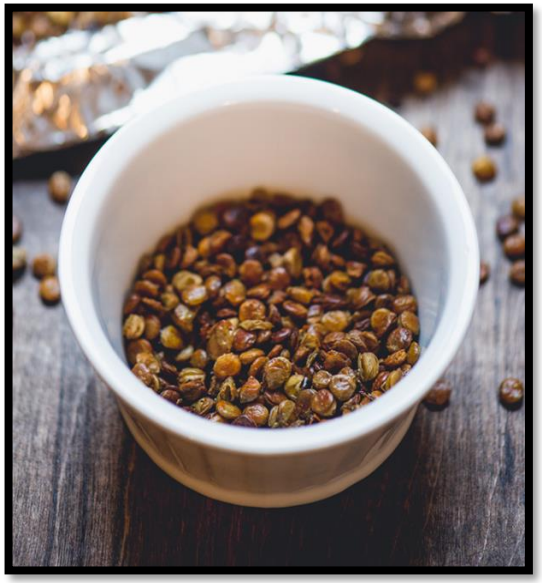
Packaging

4. ROASTED CRISPY WHOLE LENTIL:

Roasted whole lentil or Bhuni Masoor dal namkeen is a crispy, nutritious and delicious tea-time snack. This is one of the most nutritious namkeen recipes with minimum ingredients.

Raw material

- Dried whole lentils- 100 gm
- Sunflower oil-5 gm
- Garlic powder-5 gm
- Red chili pepper flakes- 2 gm
- Oregano flakes/ Cumin powder- 2gm
- Salt- 4 gm
- Pepper- 2 gm



PROCESSING

- Rinse the lentils, then put them in a jar. Add 3 times water. Bring to a boil. Reduce heat to low heat and cook for 18-20 minutes, stirring occasionally.
- Meanwhile, preheat oven to 400 F.
- Drain lentils, and then place back in the pot. Toss with remaining ingredients.
- Line with a large baking sheet of parchment paper or aluminum foil. Spread the lentils over the surface in a single sheet.
- Bake for about 12 minutes. Stir, then bake for another 12-15 minutes, until the mixture is absolutely crunchy. (Keep an eye on them for the last few minutes so as not to burn.)
- Sprinkle with salt and pepper. Let them cool down and pack.

Boiler

Boiler

Oven

Oven

Packaging machine

5. LENTIL FRIED CRACKERS

- The *split red lentils* in these crackers give them a bit more substance than store-bought crackers and add an almost nutty quality to the texture. A *spice* mix of coriander, cumin, turmeric and mustard powder gives an *Indian* curry flavour and the butter helps the crackers to melt in your mouth

Raw materials

- Red lentils - 1 1/2 cups
- Water - 1/2 cup
- Coconut oil - 2 teaspoons
- Salt - Pinch

i.Making the Dough

a)Mill red lentils in food processor or blender to create a fine flour; set 1/2 cup of red lentil flour aside.

b)Place 1 cup of the flour, 1/2 cup water and a pinch of salt in mixing bowl; combine until dough is formed.

ii.Rolling the Dough and Cutting the Crackers.

a)Generously flour work surface with red lentil flour set aside previously; place mound of dough on top floured work surface.

b)Roll dough to 1/8 inch with rolling pin covered in a sleeve or over parchment paper covering dough (to avoid sticking).

c)Cut out with 3 inch round biscuit cutter; place cut out discs on floured surface until all are ready to fry.

d)Continue to cut out discs, re-rolling dough and flouring board, until complete.

iii. Frying the Crackers

a)Place paper towel covered plate nearby.

b)Heat skillet to medium high; melt coconut oil in pan, pouring out excess and reserve.

c)Fry 4 discs at a time; turn or flip as soon as bubbles appear (in about 30 seconds).

d)Fry 15 more seconds or so; remove to paper towel covered plate to cool.

e)Repeat process until all crackers are fried, re-oiling the pan each time.

f)Store in air tight container, or freeze; crackers will be crisp, but do not have a "snap“.

Dough making Machine

Dough sheater

Dough cutting machine

Fryer

6. LENTIL BAKED CRACKERS

- Are high protein and free of gluten, nuts, seeds and grains. No frying or oil is needed as these healthy chips are oven baked. Suitable for vegan, gluten-free, grain-free, nut-free and oil-free diets.

Raw material

- Red lentils - 1 1/2 cups
- Water - 1/2 cup
- Coconut oil - 2 teaspoons
- Salt - Pinch

PROCESSING

- Making the Dough
  a) Mill red lentils in food processor or blender to create a fine flour; set 1/2 cup of red lentil flour aside
  b) Place 1 cup of the flour, 1/2 cup water and a pinch of salt in mixing bowl; combine until dough is formed
- Rolling the Dough and Cutting the Crackers
  a) Generously flour work surface with red lentil flour set aside previously; place mound of dough on top floured work surface
  b) Roll dough to 1/8 inch with rolling pin covered in a sleeve or over parchment paper covering dough (to avoid sticking)
  c) Cut out with 3 inch round biscuit cutter; place cut out discs on floured surface until all are ready to bake
  d) Continue to cut out discs, re-rolling dough and flouring board, until complete

- Baking the Crackers
  - Transfer shapes, by lifting them with a large knife or thin spatula, on a baking tray lined with parchment paper.
  - Bake for 14 minutes, then flip the crackers on the outer side. Bake for another 12 minutes.
  - Place on cooling rack.
  - Let them cool and pack.

Dough mixer

Dough sheater

Dough cutting machine

oven

7. LENTIL FINGER FRIES:

- The fingers are just perfect, nicely crispy and well spiced, good enough to tease the taste buds. Perfect for people on diet and for those who do not mind eating high calorie food.

Raw Materials

- Red lentils - 1 cup (190gms)
- Salt - 1 teaspoon
- Onion powder (granulated dried onion) - 2 teaspoons
- Garlic powder- ½ teaspoon
- Ground cumin - ½ teaspoon
- Paprika - ½ teaspoon
- Ground black pepper - ¼ teaspoon
- Water – 2 cups (480ml)
- Lemon juice - 1 tablespoon (15ml)
- Oil (I use grapeseed oil) – 2 to 3 cups (500-750ml) enough to be 1 inch (2.5cm) deep

- Combine the lentils, salt, onion powder, garlic powder, cumin, paprika and pepper in a blender. Process until finely ground, essentially a flour with a few larger granules in it.
- Pour it into a measuring cup or small bowl. You need to be able to dump the ground lentil mixture into the boiling water without stopping to scrape the last bits from the blender.
- Bring the water and lemon juice to a boil in a medium-sized saucepan. Turn the heat to medium-low and remove the saucepan from the heat (when the lentils are applied, it will splatter if you do not). Pour the lentil flour into the water in a slow stream until it is all mixed in and smooth, whisking vigorously with one hand.
- Remove the whisk and trade it for a wooden spoon. Return the saucepan to the heat and cook it, stirring constantly, for 5 minutes. The mixture will be quite stiff.
- Scrape it into the prepared pan using a rubber spatula. Have a glass of cold water nearby and keep dipping the spatula into the water as you smooth the surface of the cooked lentil mass.
- Leave it until it is cool. At this point it can be covered with plastic wrap and refrigerated overnight or up to 3 days.

- When the mixture is cool, cut it into French fry sized sticks. You can lift the whole slab out with the paper and transfer it to a cutting board.
- Heat the oil over medium-high heat in a small, deep, heavy-bottomed saucepan until it starts to slightly ripple. Drop in 1 lentil fry and wait until you see that it's followed by a lot of bubbling. Then the oil is going to be hot enough. Carefully lower the lentil sticks with a slotted spoon in the batch. At first, the oil bubbles furiously, then subsides to a slow, steady bubbling. Separate the fries in the oil gently with the spoon as they fry.
- Let them fry for 5 to 8 minutes, depending on the heat of the oil and size of the fries, until they are a rich golden brown, stirring them occasionally with a slotted spoon to distribute them. Letting them get deep golden will make them more crisp than if they're just a lighter shade.

Refrigerator

Fryer

Cutting machine

8. CRISPY LENTIL ENERGY BITES

- These Crispy Lentil Energy Bites is unique vegan and gluten free treat recipe. Lentils are crisped up in the oven giving these bites a one-of-a-kind flavour.

Raw materials

- Green lentils - ½ cup
- Coconut oil, melted - ½ tbsp
- Coconut sugar - 1 tsp
- Cinnamon - ½ tsp
- Coconut flour - 1 tsp
- Sea salt - 1⁄8 tsp
- Oats - 2 cups
- Coconut, unsweetened, shredded - ¼ cup
- Pumpkin seeds - ¼ cup
- Dark chocolate chips - ¼ cup
- Peanut butter - ½ cup
- Honey or maple syrup (or a combination) - ½ cup

PROCESSING

- Preheat oven to 400°F. Line a baking sheet with parchment paper.
- Rinse lentils and transfer them to a small saucepan.
- Cover with 2 cups of water and bring to a boil.
- Lower heat to medium and simmer for 15 minutes.
- Drain and transfer to a small mixing bowl.
- Stir in the coconut oil, and coat lentils well.
- Sprinkle with the coconut sugar, cinnamon, coconut flour, sea salt, and stir well.
- Spread lentil mixture evenly onto lined baking sheet and bake for 15 minutes, stirring halfway through, keeping an eye on them so they do not burn. Set aside to cool.
- Meanwhile, in a large mixing bowl, stir together the oats, seeds, coconut, and chocolate chips. Add in crispy lentils, then the peanut butter and honey/maple syrup and stir well again.
- Roll into heaping tablespoon sized balls and refrigerate for 30 minutes to set. Store covered in the fridge or freezer.

Cutting machine

refrigerator

oven

EXPORTING STATUS

- Lentil is export around the world from India.
- The data given for the export study indicates that approximately 90 countries and territories are actively importing Lentil from India.
- In FY 2020-2021 (Apr-Nov), Around 7.6 USD million value of Lentil was exported from India to Bangladesh. It was around 58.55% of the total export of Lentil.
- The combined value of total export is 12.98 USD million in the year of 2020
- Top 5 countries which are export from India are Bangladesh,USA,Bhutan, Qatar, Nepal
- The value of Lentil exported from India in October 2020 was 1.25 USD million .
- India exported Lentil to 81 countries with a total amount of USD 17.51 million back in 2014, which changed to 91 countries in 2015 and 103 countries in 2018.

Source: Connect2India.com

MOFPI
MINISTRY OF FOOD PROCESSING INDUSTRIES
GOVERNMENT OF INDIA

PM FORMALISATION OF MICRO FOOD PROCESSING ENTERPRISES SCHEME (PMFME)

TOTAL OUTLAY: RS.10,000 CRORE

- **2,00,000** FPOs/SHGs/Cooperatives and working micro enterprises to be directly benefitted
- Expected to generate **9 lakh** skilled and semi-skilled jobs
- To be implemented over a **5-yr period from 2020-21 to 2024-25**
- Cluster approach
- Focus on Perishables.

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