

## Study of Environmental Impacts on Quality and Food Safety Aspects of Some Selected Pulses

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### ABSTRACT

The pulses are important part of dietaries and contribute significant nutrient intake of human beings. They are important source of energy, protein, dietary fiber, vitamins, minerals, and phytochemicals. Primary processing of cereals and legumes is an essential component of their preparation before use. There are some pulses ( Arhar /Tur, Moong Dal) those are processed through dehusking, i.e. essential process steps in their preparation. The processing and treatments impart special characteristics and improve organoleptic properties of pulses. However processing improves the quality but the treatments result in alteration of their nutritional values which could either be reduction in nutrients. Post to the processing Pulses become more susceptible and in adequate environmental exposure boost the deterioration of nutritional contents .Throughout food supply chain due to lack of awareness trading system does not pay attention on adequate storage of pulses, these are remained stored either in higher temperature or in high humidity .Till the pulses reach to the consumers its nutritional values gets reduced, supply inferior Quality products for consumer in the market

**Key words:** Nutritional values, Food supply chain, Nutritional Content, Quality

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### I. INTRODUCTION

Legume, botanical name Leguminosae or Fabaceae, Legume plant is grown agriculturally and their seeds are called as Pulses. The key legume pulses are, Peas, Chick peas, Gram, Toor / Arhar, Moong, lentils, soyabeans, Peanuts .Legume is simple dry fruit that develops from a simple carpel and such fruits are called commonly as pod. Pulses are grown in different part of India , Uttar Pradesh , Maharashtra, Kerla, Rajasthan, Andhra Pradesh, Madhya Pradesh pulses are cultivated in other states of India also, but not up to larger scale.

Tur is cultivated in a wide range of soils from black clay to sandy soil, but very sensitive to Water logged conditions. Being a drought resistant crop, it is best suitable for dry-land farming and predominantly used as an intercrop with other crops like cotton, sorghum, ground nut, black gram etc., to increase the yield and maintain soil fertility, because of presence of nitrogen fixing bacteria in the roots of plant. It is normally cultivated during rainy season beginning from June July and ends in November – December. Tur is a kharif crop in India and arrivals start from October and extend till December

Green pigeon pea( Tur) pods are harvested for different purposes. Fully developed, bright green seed is preferred for use as a vegetable. Hence, pods

should be harvested just before they start losing their green color[11]. For this normally hand picking is followed.

Pigeon pea leaves, unlike other crops, remain green when the pods are ready for harvest. This may confuse decision on optimum harvest time. Pigeon pea should be harvested when 75-80% of the pods turn brown and are dry.

Delayed harvesting, during bad-weather, may increase the risk of damage to mature seed. Traditionally pigeon pea plants are harvested by cutting the stem at the base with a sickle, but occasionally machines are used for cutting and followed by drying and threshing.

The harvested plants are bundled and placed upright to dry for a week depending on the weather conditions. Pods and grain are separated by beating the dry plants with sticks or by using a thresher. In some places by cattle trampling seeds are separated. In some places matured pods of pigeon pea are harvested by hand picking. This allows the crop to flower and pod for a second or sometimes a third harvest. But hand-picking may not be economical beyond a second flush. When hand-picking of pods is not feasible, the upper branches with mature pods are cut and threshed.[10]

The olive-green mung beans is harvested in the field after their pods have dried, typically in early to mid-September. Farmers use the same type of combine machinery used to harvest soybeans, but because mung beans are smaller than soybeans, they adjust the combine settings and screen size for the smaller bean size. Mung beans is cleaned of debris before storage, and the beans should have no more than 12 percent moisture content for storage. Because harvested beans may be sprouted and eaten directly, stored beans should not be treated with fungicides, insecticides or bactericides.[4]

Tur dal is source of carbohydrates, which your body needs for energy. Legumes such as toor dal contain complex carbohydrates, which are recommended because of their increased nutritional value. It provides many of the nutrients your body needs, such as protein, fat, fibre and carbohydrates. It is very nice source of protein in Indian Cooking specially Vegetarian. It also has a good amount of iron, calcium, magnesium, potassium and B vitamins. It is high in dietary fibre, low in saturated fat, and cholesterol free. Toor dal contains folic acid, an important vitamin for all women especially those planning to become pregnant. It helps to cure cough, poisoning effect, gas troubles, acidity, stomach pain and pile. Legumes are a high source of nutrients including: manganese, potassium, magnesium, folate, copper, zinc and various B vitamins. They are also a very good source of , high in protein, resistant starch and dietary fibre. Because of their high nutrient density, mung beans are considered useful in defending against several chronic, age-related diseases, including heart disease, cancer, diabetes and obesity.

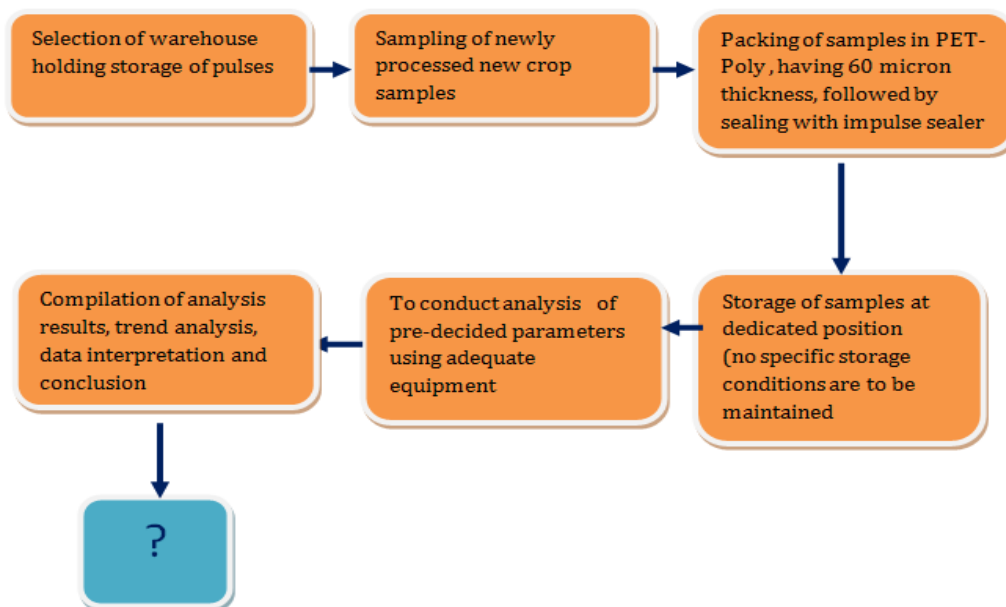
**Area of study:** The study was conducted in Delhi NCR region. For this purpose the storage location of pulses in Delhi NCR was selected . The conditions of storage locations i.e. in terms of GSP( Good storage practices) monitored and recoded , at some of the locations storage conditions were found adequate whereas at most of the locations storage conditions were not found satisfactory for storage of pulses.

**Sampling:** The samples were drawn from both storage conditions as well from new crop pulses i.e. Tur Dal and Moong Dal. The sampling was carried out using formula  $\sqrt{n+1}$ . Samples were packed in preformed poly having 60 micron thickness. The integrity of packed samples was assured .Three samples of each variant was collected i.e. new crop samples means crops harvested and processed within one month. Total no. of samples collected 10, (05 samples Tur Dal +05 samples (Moong Dal) packed. During sampling standard quality practices were followed. The study was conducted in year 2015-2016

**Inspection of samples:** The samples were packed in Pet-Poly and finally sealed using impulse sealer .The packaging integrity was checked properly in terms of “pin holes, sealing condition “.

**Requirements for study:** The dedicated area in warehouse for adequate storage of sampled products. The environmental conditions of warehouse are kept same it remain in routine operations. Equipped laboratory for analysis of physical, and chemical contents of samples. The key required equipment are as protein analyzer, moisture content analyzer. The analysis is to be conducted using validated method in NABL accredited laboratory

**Process Flow:**



**Analysis:** The analyses of samples were conducted at two stages. The first stage analysis was conducted just post to the sampling. Later on analysis was conducted after holding of samples at periodic intervals for both Pulses (Tur Dal/ Moong Dal). The parameters covered during analysis are as under:

- Sensory(Taste,Odour,Appearance)

- Moisture Content
- Acid Insoluble Ash
- TotalAsh
- Uric acid
- Aflatoxins

Parameters	Results : Analysis pattern: Tur Dal		
	Initial Testing	30 <sup>th</sup> day	60 <sup>th</sup> day
Moisture content	11.21% w/w	12.75% w/w	14.12% w/w
Insect infestation	Nil	Nil	Nil
Taste	Characteristics	Characteristics	Slight off taste
Odour	Characteristics	Characteristics	Slight of odour
Appearance	Light Yellow Coloured small pallets	Light Yellow Coloured small pallets	Light Yellow Coloured small pallets
Acid insoluble ash	0.25% w/w	NA	NA
Total ash	4.85% w/w	NA	NA
Uric acid	44.73 mg/Kg	57.19 mg/ Kg	68.88 mg/ Kg
Aflatoxins(B1,B2,G1,G2)	Not detected	Not detected	Not detected
<b>SENSORY EVALUATION (After Cooking)</b>			
Taste	Characteristics	Characteristics	Slight off taste
Odour	Characteristics	Characteristics	Slight of odour
Appearance	Light Yellow Coloured small pallets	Light Yellow Coloured small pallets	Light Yellow Coloured small pallets

Parameters	Results : Analysis pattern: TUR DAL	
	90 <sup>th</sup> Day	120 <sup>th</sup> Day
Moisture	16.91% w/w	17.43% w/w
Insect infestation	Nil	Nil
Taste	Off taste	Tasteless
Odour	Off taste	Tasteless
Appearance	Light Yellow Coloured small pallets changing to light brown colour	Light Yellow Coloured small pallets changing to light brown colour
Acid insoluble ash	NA	0.21% w/w
Total ash	NA	4.71% w/w
Uric acid	82.00 mg/ Kg	96.72 mg/Kg
Aflatoxins(B1,B2,G1,G2)	Not detected	Not detected
<b>SENSORY EVALUATION (After cooking)</b>		
Taste	Off taste	Tasteless
Odour	Off taste	Tasteless
Appearance	Light Yellow Coloured small pallets changing to light brown colour	Light Yellow Coloured small pallets changing to light brown colour

**Table-1:** Content showing parameters of analysis ( Tur Dal)

Alteration in results reported during experimental Study:

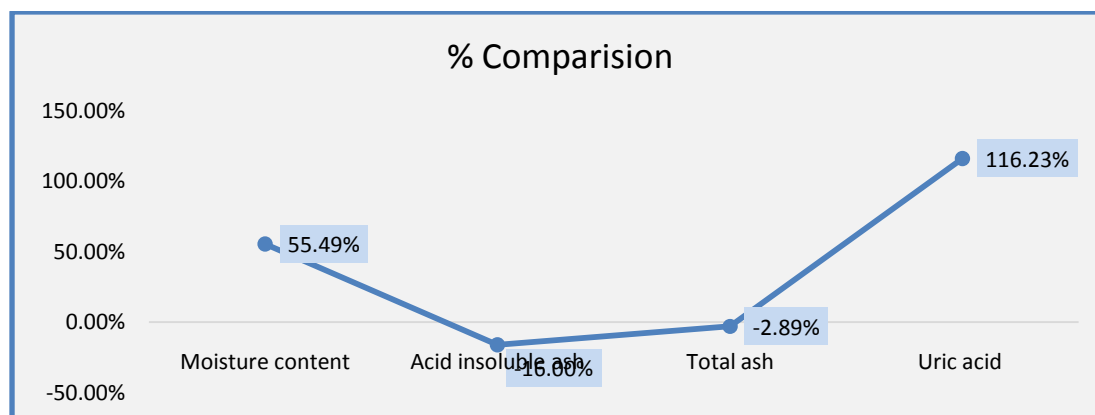
Parameters	%age of alteration
Moisture content	55.49%
Acid insoluble ash	-16.00%
Total ash	-2.89%
Uric acid	116.23%

**Table-2:** Content showing altered parameters analysis results

Parameters	Results comparative
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	Initial Testing	30 <sup>th</sup> day	60 <sup>th</sup> day	90 <sup>th</sup> Day	120 <sup>th</sup> Day
Moisture content	11.21% w/w	12.75% w/w	14.12% w/w	16.91% w/w	17.43% w/w
Acid insoluble ash	0.25% w/w	NA	NA	NA	0.21% w/w
Total ash	4.85% w/w	NA	NA	NA	4.71% w/w
Uric acid	44.73 mg/Kg	57.19 mg/ Kg	68.88 mg/ Kg	82.00 mg/ Kg	96.72 mg/Kg

**Table-3:** Content showing comparative results



**Fig-1:** Showing graphical presentation

Parameters	Results :Analysis Pattern : Moong Dal		
	Initial Testing	30 <sup>th</sup> day	60 <sup>th</sup> day
Moisture content	14.5% w/w	16.80% w/w	18.25% w/w
Insect infestation	Nil	Nil	Nil
Taste	Characteristics	Change in the taste	Bitter in taste
Odour	Characteristics	Off odour	Off odour
Appearance	Yellow Coloured small pallets	Yellow Coloured turning greenish appearance Initiation of lumps formation	Yellow Coloured turning greenish appearance Initiation of lumps formation
Acid insoluble ash	0.18% w/w	NA	NA
Total ash	3.70% w/w	NA	NA
Uric acid	23.56 mg/Kg	62.53 mg/ Kg	79.23 mg/ Kg
Aflatoxins(B1,B2,G1,G2)	Not detected	Not detected	Not detected
<b>SENSORY EVALUATION (after cooking)</b>			
Taste	Characteristics	Change in the taste	Bitter in taste
Odour	Characteristics	Off odour	Off odour
Appearance	Yellow Coloured small pallets	Yellow Coloured turning greenish appearance Initiation of lumps formation	Yellow Coloured turning greenish appearance Initiation of lumps formation

Parameters	Results comparative	
	45 <sup>th</sup> Day	60 <sup>th</sup> Day
Moisture	21.07% w/w	22.32% w/w
Insect infestation	Nil	Nil
Taste	Taste less	Taste odour
Odour	Puffed odour	Puffed odour
Appearance	Greenish colour turning brownish appearance Caking formation of pulses Fungal growth	Colour changed to darker brownish in appearance Caking formation of pulses

Acid insoluble ash	NA	0.14% w/w
Total ash	NA	3.27% w/w
Uric acid	92.57 mg/ Kg	101.80 mg/Kg
Aflatoxins(B1,B2, G1,G2)	Not detected	Not detected
<b>SENSORY EVALUATION (After cooking)</b>		
Taste	NA	NA
Odour	Puffed odour	Puffed odour
Appearance	Greenish colour turning brownish appearance Caking formation of pulses Fungal growth	Colour changed to darker brownish in appearance Caking formation of pulses

**Table-4:** Content showing parameters of analysis ( Moong Dal)

Alteration reported in paramters during experimental study:

Parameters	%age of alteration
Moisture content	53.93%
Acid insoluble ash	-22.22%
Total ash	-11.62%
Uric acid	332.09%

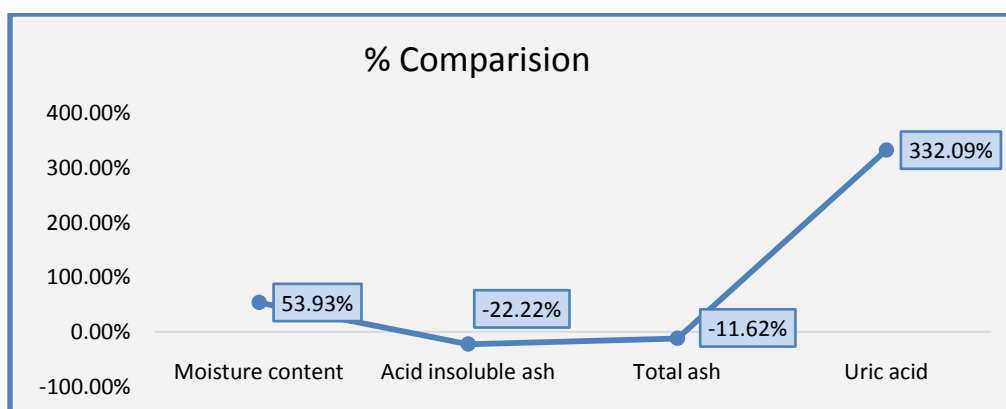
**Table-5:** Content showing

results

altered parameters analysis

Parameters	Comparative Results				
	Initial Testing	30 <sup>th</sup> day	60 <sup>th</sup> day	90 <sup>th</sup> Day	120 <sup>th</sup> Day
Moisture content	14.50% w/w	16.80% w/w	18.25% w/w	21.07% w/w	22.32% w/w
Acid insoluble ash	0.18% w/w	NA	NA	NA	0.14% w/w
Total ash	3.70% w/w	NA	NA	NA	3.27% w/w
Uric acid	23.56 mg/ Kg	62.53 mg/ Kg	79.23 mg/ Kg	92.57 mg/ Kg	101.80 mg/ Kg

**Table-6:** Content showing comparative analytical results



**Fig-2:** Showing graphical presentation

Physical and Chemical Analysis: Taste & odour of the product was analyzed through organoleptic method of analysis for sensory team was built based on Indian standards Guidelines , prior to startup of analysis the sensory panelist were validated . The results were recorded systematically

to conclude the final results. Appearance of the product was also analyzed through sensory panel. The insect infestation in the product was analyzed through visual inspection. Pertaining to the determination of moisture content product ( 5.0 gram sample) was exposed at 130-133 degree cel. For two

hours and reading was noted post to the constant three successive readings. [2]

Total ash was determined by using Muffle furnace for which 5.0 gram sample quantity was exposed at 800 degree cel. for four hours, followed by cooling of sample in desiccators and weighing using calibrated weighing balance, till constant readings of samples.

**Calculations:**

Total Ash, percent by mass=  $\frac{100(M2-M1)}{M2-M1}$

**Calculation:**

$$\text{Acid insoluble Ash \%} = \frac{(\text{Weight of crucible with residue} - \text{weight of empty crucible}) \times 100}{\text{Weight of the sample}}$$

The analysis of Aflatoxins (B1, B2, G1,G2) was carried out using LC/MS/MS,

Aflatoxins (AFs) belong to a closely related group of secondary fungal metabolites. These mycotoxins are severely toxic metabolites produced mainly by *Aspergillus flavus* and *A. parasiticus*, and exposure to them can cause cancer in humans and livestock. Based on epidemiological evidence, Aflatoxins have been classified as human liver carcinogens by the World Health Organization and by the U.S. Environmental Protection Agency. Thus, accurate determination of AFs is required to avoid human.

Each of the standard reagents, Aflatoxin G2 (AFG2), Aflatoxin G1 (AFG1), Aflatoxin B2 (AFB2) and Aflatoxin B1 (AFB1), was dissolved in acetonitrile at 1 mg/mL and was stored at 4 °C in the dark until use. To prepare the working standard for LC/MS analysis, each AF stock solution was equally pipetted and transferred to a vial, and it was then diluted with the mobile phase. The final concentration of each AF was 1 ng/mL[1][2]

The extraction and cleanup steps for Aflatoxins (B1, B2,G1,G2) were carried out according to validated methods. Briefly, 20 g fine ground sample was poured into a 200-mL Erlenmeyer flask, followed by adding 40 ml acetonitrile-water (9:1, v/v) for corn and cereals. After shaking for 30 min, the mixed solution was centrifuged for 5 min at 1,650 g. The supernatant obtained was filtered through a glass microfiber GF/B grade filter. The required conditions of LC/MS/MS was maintained till the completion of analysis of product. The method of quantification was applied to determine the quantitative value of Aflatoxins (B1, B2,G1,G2)[1][2][3].

**II. DISCUSSION AND CONCLUSION**

M1-M

Where,

M= Mass of the empty dish, in g

M1= mass of the dish with the material taken for test, in g and

M2=mass of the dish with the ash, in g

The similar steps were followed as in case Total ash for the determination of acid insoluble ash, additional step was dissolving and drying of estimated ash content in hydrochloric acid. The calculation was done based on the formula as under:

The experimental study conducted on Tur Dal & Moong Dal shows that there are significant changes when the products stored in ambient conditions. The initial characteristics of products stand within the range of standards of quality and food safety and product remain safe for consumption. The analysis shows that the results of parameters are changing for Tur Dal & Moong Dal, along with storage duration moisture content 55.59% and 53.3%, acid insoluble ash 16.0% 22.22%, Total Ash, 2.89% & 11.62%, there is higher change in Uric acid level in both the cases i.e. 116.23% and 332.09%, which indicate the infestation in the products and finally make product unsafe to consume.

Based the data interpretation it is concluded that storage of product Tur Dal & Moong Dal in non-ambient condition is not safe. Due to exposure of higher humidity, product gets deteriorate faster, and loss its nutritive values, enhancement of value of uric acid as contaminants higher than the permissible limit (FSSAR-2011, limit 100ppm) make food product unsafe for human consumptions [6]. It also indicate that there is loss of protein content due to deterioration protein content in the form of uric acid.

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