Survey Research on Status of Pulses Buffer Stock in India

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ABSTRACT
Pulses are the chief source of protein in routine diet of Indian vegetarian population. During 2016-17 an unprecedented production of 22.95mt and import of 3.11mt had created a surplus buffer stock of pulses. Government of India had decided to liquidate the pulses buffer stock after examining the quality of stocks to accommodate the fresh arrival. The Department of Consumer Affairs (DoCA), has identified ICAR-IIPR to conduct survey research at 10 locations across the country on existing pulses buffer stock. A team of three members from ICAR-IIPR surveyed, observed and collected 47 samples of pulses (pigeonpea, chickpea, green gram, black gram and lentil) from 26 warehouses. The collected samples were analyzed for grain refractions and milling recovery. The physical observations on ventilation at godowns, bags, dunnage, stack size, sampling and maintenance of stocks were discussed in this article.

Key words: Buffer stock, Pulses, Shelf life, Storage longevity, Survey.

INTRODUCTION
Indian sub-continent majorly depends on pulses for their regular protein requirement. Historical and available data showed India has started imports and exports of pulses long back 1950’s but considerable trade started from 1992. The scenario between 1992 and 2013 has demonstrated significant improvement, exports (from 0.03 to 0.34mt) figures are far too low compared to imports (from 0.38 to 3.04mt) (Directorate of Pulses Development, 2015). Moreover, reasons like less digestible protein, anti-nutritional factors, non-vegetarian food habits in rest of world, high demand for vegetarian protein in India and less pulses production levels have shrunk the international market and trade of pulses. Some or all of these circumstances pushed the India neither self-sufficient nor in position to export pulses. India is the largest producer (25 percent), consumer (27 percent) and importer (14 percent) of pulses in the world (Mohanty and Satyasai, 2015). In India before green revolution i.e. 1950-51, pulses occupied an area of 19.0mha with 8.4mt production. Post Green revolution farmers with irrigation facility switched to more stable cereal crops like wheat and paddy. Adoption of high yielding varieties and new technologies had spread the area under pulses to 24mha with 17mt production as on 2011-12 (Latika Devi et al. 2017). Indian population has scaled up from 36 crores (1951 census) to 125 crores (2011 census) (Census India, 2019). In fact, during five decades (1951-2011) the population of India has increased to 3.5 times compare to 2-fold increase in pulses production. During 2011-12 India had experienced a shortfall of 3.0mt against targeted pulses production of 20mt. Considering the recommendations of Indian Council of Medical Research [consumption of 40g of pulses per day for a balanced diet of an average sedentary man (Lansa, 2019), the deficient in pulses production had badly hit the pulse based protein diet in India. The factors like continuous monsoon failure, negligible increase in Minimum Support Price (MSP) for pulses and availability of alternative protein sources (egg, chicken etc.) had created situation much worst in succeeding years (from 2011 to 2014), which led to unprecedented hike in retail prices of pulses during 2015. To mitigate the price volatility of notified crops like Onion, Potato and Pulses, a corpus – Price Stabilization Fund (PSF) was created by Ministry of Consumer Affairs, Food and Public Distribution w.e.f 01st April 2016.

To neutralize the fluctuation of pulses retail price, an idea of creating pulses buffer stock during 2015 has propelled the Government of India to import (0.37mt) and local procurement (2.74mt) of pulses by various trading bodies like Metals and Material Trading Corporation (MMTC) and National Agricultural Cooperative Marketing Federation (NAFED), respectively. The imported and procured pulses were stored at Central Warehouse Corporation (CWC), State Warehouse Corporation (SWC) and other private godowns throughout the country in 400 locations (Economic Times, 2017). The Department of Consumer Affairs (DoCA) was being authorized for imports, purchase, maintenance, liquidation and other related issues of pulses buffer stock. The record production of pulses (23mt) in 2016-17 placed DoCA in difficult position despite the best intention and efforts, the millers did not lift the buffer stock of pulses as prevailing market prices were quite low due to improved
pulses production (Financial Express, 2017.). The following questions were aroused at DoCA like (1) How long pulses can be stored safely? 2) What is the pulses shelf life? 3) What is the quality of pulses buffer stock? and 4) Can pulses buffer stock be diverted to public distribution system? In search of answers, DoCA has been approached ICAR-Indian Institute of Pulses Research (IIPR) to conduct survey research on buffer stock of pulses. The Director, ICAR-IIPR has constituted a team to examine the status of pulses buffer stocks including expertise in Agriculture Structures and Process Engineering, Agricultural Entomology and Agricultural Microbiology. The aim of this study is to provide the status (in qualitative terms) of buffer stock and further recommendation for safe storage of pulses.

MATERIALS AND METHODS

A team from ICAR- IIPR had surveyed, observed and sampled pigeonpea, chickpea, green gram, black gram and lentil grains in 26 warehouses from ten DoCA selected locations across the country. The locations were chosen in such an order that five locations (Chennai, Krishnapatnam, Mumbai, Kandla and Mundra) holding imported pulses and other five locations (Kalburgi, Osmanabad, Latur, Jalna and Bikaner) have local procured pulses from markets (mandes). Employing Bureau of Indian Standards (2000) methodology, 1kg of representative samples was collected for each pulse crop per location to observe the refractions and potential milling recovery. Likewise, a total of 47 samples were collected across the locations and brought to the ICAR-IIPR for further laboratory studies. The collected one kg sample was reduced to 100g by coning and quartering method to find out the refractions. The refractions like foreign matter (FM), other food grains (OFG), damaged grains (DG), broken grains (BG), shriveled grains (SG) and bruchid damaged grains (BDG) were observed in sampled pulses by adopting guidelines provided by Department of Agriculture, Cooperation and Farmers Welfare, 2015. Furthermore, potential milling recovery was also assessed from each sample. The total soluble protein content in each pulse grains sample was estimated using Lowry method. One gram of seed powder was ground into 10 ml of extraction buffer (0.1M phosphate buffer pH 7.5) followed by centrifugation @ 10000 g for 20 minutes at 4°C. The supernatant was used for protein estimation using standard protocol (Lowry et al., 1951). Apart from these studies, team had made their own observations on age of stock, type of storage, gunny bag (made, capacity, stitching, arrangement), godown structure (doors, roof, floor, walls), origin of pulse stock, display of data sheets, stack size, spillage of grains, type of dunnage, aisle (alley ways), frequency of sampling, prophylactic and curative measures, ventilation of godown and charges incurred on storage, loading and unloading. Milling recovery was estimated in lab scale universal grain testing mill (50g sample was milled for 5 seconds). The dehusked grains were weighed to determine milling recovery.

RESULTS AND DISCUSSION

The trading body, MMTC of India was involved in importing of pulses from different parts of the world and their safe storage. Pigeonpea was imported from Mozambique, Myanmar, Malawi and Tanzania; Chickpea from Australia; Black gram from Myanmar; Lentil from Canada. Likewise, NAFED has been given responsibility for local procurement from farmers' societies at markets (mandes) and their safe storage. Both MMTC and NAFED had hired CWC, SWC and private godowns for storing pulses on payment basis.

Ventilation of godowns

Most of the godowns visited were furnished with roof (corrugated asbestos/tin sheets/colour coated tin sheets) with provision for sunlight and were fitted with turbine fans, doors (with shutters), walls (meshed windows) and floor (concrete). Rodent-proof constructions are observed in almost all godowns. Even though, godowns have provision of turbine fans and meshed windows for proper air circulation, the existing shutters that are kept open for only 8hrs per day and closed rest of the day, which do not allow sufficient air to circulate. This condition initiates the moisture built-up in the godown, which ultimately affects the pulses stock. A provision for natural or forced air circulation must be there to prevent moisture built-up in the godown.

Storing bags

The imported pulses were transported in 50kg capacity polypropylene (PP) woven bags (machine or manually sewed). While, procured pulses within country were stored in 50kg capacity jute bags (machine or manually sewed). The notable observations like collapse of stacks, leakage of grains, bursting of lower stack bags, pillow formation and entry of bruchid. All those observations were ascertained to over filling of manually sewed PP woven or jute bags. It was entrusted to draw an inference that machine stitched PP woven and jute bags were better for storing the pulses. Other feature like uniform size, texture, insecticidal pretreatment feasibility and moisture absorption ability of the jute bags were also equally important.

Dunnage and stack size

Different types of materials were used for dunnage like wood, bamboo, black polythene sheets and High Efficiency Flooring (HEF). Even though wooden or plastic dunnage was most popular practice in godowns, very few were practicing it. Termite attack and collapse of stacks (on over stacking) are the major setbacks of wooden dunnage. These drawbacks led to use alternatives like bamboo mat, black polythene sheets and High Efficiency Flooring (HEF). The HEF (both side laminated on jute fiber woven sheet) dunnage was found more efficient dunnage system over others. Because of hierarchical pressure and limited space in godowns the stacks were kept in 20-30×20-30×16-24 (L×W×H) bags range across the location with no or less aisle. The stacks with more than 16 bags height were not only more vulnerable to collapse but also difficult to go for
curative operations like fumigation and may result in bursting of lower stack bags.

**Inspection**

A three-tier examination (during loading, storage and delivery) was followed for both imported and procured pulses to enumerate the refractions, moisture content, stored grain pest infestation etc. At first stage of examination – imported pulses consignment after reaching to India, Clearing and Handling Agents (CHA) examine the lot at port. At second stage - Société Générale de Surveillance (SGS) or National

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**Fig 1:** Comparison of refractions (a) irrespective of origin of pulses (b) irrespective of location among imported pulses and (c) irrespective of location among procured pulses.
Collateral Management Services Ltd. (NCML) hired employees or CWC technicals examine the imported pulses before storing in a godown and fortnightly observation during storage. Whereas for local procurement, NCML employees are hired by NAFED to estimate the Fair Average Quality (FAQ) of pulses before procurement of pulses from farmers. Later technical staff at godown (CWC or SWC) examine the pulses before storage and also conduct fortnightly observation during storage. Final examination of both imported and procured pulses done during delivery by the buyer as per the requirement. A sampling instrument (Sampling spear) is being used in godowns to get sample of grains fortnightly from the bags. It was observed that most of punctures on bags were unclosed, which may become portal for bruchid to enter into the bags, spillage of grains, collapse of the stacks etc. These punctures were because of repeated sampling and hooking (during loading/delivery) of the bag. This problem was more intense in PP woven bags compared to jute bags. To overcome this, a storage bags should be designed with one-way opening for sampling and hook catch holes with grommet at the corners of bag.

**Maintenance of stock**

The pulses stocks stored at different surveyed locations were maintained as per Department of Agriculture, Cooperation and Farmers Welfare, (2015) guidelines. Prophylactic measures like spraying of Malathion 50%EC or Deltamethrine 2.5%WP and DDVP 76%EC on stacks and walls/floor/roof, respectively are being practiced. The inspection periodicity of stocks in godown was fortnight. Hardly our team has observed the cleanliness of godowns,

Fig 2: Observed refractions across the locations in (a) Pigeonpea (b) Chickpea (c) Green gram (d) Black gram and (e) Lentil irrespective of origin of pulses.
cleanliness comprises, sweeping of godowns to remove grain spillage and dust, removal of webbings and accumulated dust from various places of godowns and brushing of grain bags. Every godown as both prophylactic and curative measure, following fumigation of pulses grains with Aluminium Phosphide (AIP) to minimize the bruchid infestation in jute bags unlike PP woven bags, since penetration capacity of Phosphine (PH3) gas into PP woven bags was less compared to jute bags. It was observed that fumigation of the imported pulses packed in PP woven bags was also being done by AIP. Fumigation of pulses before packing in PP woven bags create hostile condition to bruchids.

Refractions, soluble protein and milling recovery

Although the refractions in the collected samples were at low level (as per Department of Agriculture, Cooperation and Farmers Welfare, (2015) guidelines) but there are numerical differences across the locations. The noticed refractions (foreign matter, other food grains, damaged grains, broken grains, shriveled grains and bruchid damaged grains) illustrated the imported lentil from Canada had higher average refractions percent of 1.7% by weight compared to other pulses. The average immature/shrunked/shriveled and unripe grains were more in pigeonpea (2.94%), chickpea (2.7%), black gram (2.86%) and lentil (4.11%) compared to other refractions. But in green gram more broken/split grains (3.49%) was observed over other refractions. It was detected that imported pulses has presented high (1.27%) average refraction percent by weight over procured pulses (0.93%). Within imported and procured pulses, lentil (1.7%) and chickpea (1.43%) have more average refraction percent, respectively. The pigeonpea stored at Mundra port location was noticed with 1.6% average refraction percent that was more than other storage locations. The high (1.43%) average refraction percent was noticed in chickpea stock placed at Bikaner location. At Osmanabad location, the stored black gram was observed with high average refraction percent (1.22%). The lentil showed high average refraction of 2.01 percent from Mumbai location (Fig1 and Fig 2). No microbial growth or contamination was noticed in the surveyed locations. The order of milling recovery for different pulses was as followed lentil (89.75%)-chickpea (85.53%)-black gram (85.1%)-pigeonpea (83.97%)-green gram (83.1%). The values of milling recovery indicate sound health of stored pulses. The soluble protein content of stored pulses decreased marginally when compared against the soluble protein content of freshly harvested pulses.

CONCLUSION

Technically the perishable products (vegetables, fruits etc.) have shelf life, so proper and systematic implementation of above paradigm shifts must replace the misnomer ‘shelf life’ with ‘storage longevity’ of pulses. One can forecast the pulses storage longevity and quality based on condition of pulse grains before (removal of field carry-over population of bruchids by prophylactic fumigation with AIP, proper drying of grains to achieve optimum moisture content and hermetic bag storage) and during storage (prophylactic and curative measures, cleanliness, proper ventilation of godowns and regular monitoring of stocks). In addition to above, since earlier studies were lacking under this scope, long-term experiments must be initiated to estimate the storage longevity and quality of pulses in different agro-climatic locations of India.

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REFERENCES

Bureau of Indian Standards (2000). Indian Standard Cereals and Pulses and Milled Products – Sampling of Static Batches (ICS 67.060). Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002.

Department of Agriculture, Cooperation and Farmers Welfare (2015). Procurement of Pulses under Price Stabilization Fund (PSF) – Quality Specification of Tur and Urad. In: 20th meeting of PSFMC, Shastri Bhawan, New Delhi dt 04.12. 2015.

Directorate of Pulses Development (2015). Annual Report 2015-16. pp.8.

Latika Devi, Y. Arivelarasan, T. and Jenny K. (2017). Pulses Production in India: Trend and Decomposition Analysis. Economic Affairs. 62(3): 435-438.

Census, (2019). http://censusindia.gov.in (accessed on 12th June 2019).

Lansa, (2019). http://lansasouthasia.org/blog/pulse-consumption-india (accessed on 9th June 2019).

Economic Times, (2017). http://economictimes.indiatimes.com/news/economy/agriculture/india-imports-50-8-lakh-ton-pulses-for-rs-17280-crore-in-april-december/articleshow/62808888.cms?from=mdr (accessed on 10th June 2019).

Financial Express, 2017. https://www.financialexpress.com/market/commodities/record-pulses-bufferstock-turn-into-headache-for-centre-here-is-why/809987 (accessed on 11th June 2019)

Lowry, O. H., Rosenbrough, N. J., Farr A. and Randall R. J. (1951). Protein measurement with the Folin phenol reagent. Journal of Biological Chemistry. 193: 265-75.

Smitha, M. and Satyasai, K.J. (2015). Felling the pulses: Indian Pulse Sector. NABARD Rural Pulse. 10th issue.