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SHELF LIFE STUDY REPORT OF MAKHANA (FOX NUTS)

SAMPLE SUBMITTED BY:

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Sample Id. / Identification
LAB / FOOD / SL / 2026 / 002
Sample Quantity
1.5 Kg. (In Clean, Sealed, Food – Grade Packaging).
Sample Description
Raw Fox Nuts (Makhana) (Unroasted , Dry Food Product).
Sample Condition
Good

STUDY OBJECTIVE

To evaluate the stability characteristics of **MAKHANA (Fox Nuts)** and to **predict the shelf life (Predictive) under normal storage conditions** using an Accelerated Shelf Life Study (ASLT).

SAMPLE & STUDY DETAILS

- **Sample Receiving Date**: 29-10-2025
- **Study Start Date (Day 0)**: 04-11-2025
- **Final Observation Date (3 Months - Accelerated)**: 02-02-2026
- **Report Issue Date**: 03-02-2026

PACKAGING CONDITION

Samples were received in sealed , Food – Grade packaging (market-intended).
Separate unopened packs were used for each observation interval.
Each pack was opened only once at the defined interval for testing.

STORAGE CONDITIONS

Condition	Temperature	Relative Humidity
Normal Storage	25 ± 2 °C	60 ± 5 % RH
Accelerated Storage	37 ± 2 °C	75 ± 5 % RH

STUDY DESIGN & METHODOLOGY

An **Accelerated Shelf Life Study (ASLT)** was conducted to evaluate product stability over a defined period. The accelerated storage condition was selected to accelerate quality deterioration mechanisms such as **lipid oxidation and moisture ingress / migration (dependent on packaging barrier properties)** in low-moisture dry foods.
Accelerated data are used **only for predictive estimation** of shelf life under normal storage conditions.

ACCELERATED SHELF LIFE CORRELATION SUMMARY

Shelf life correlation was performed using an **empirical Q10-based approach** as per internal validated ASLT SOP.
Assumed Q10 value : 2.0

- **Temperature differential (ΔT) :** 12 °C (37 °C vs 25 °C)
- **Acceleration Factor (AF) :** AF = Q10^(ΔT / 10) ≈ 2^(1.2) ≈ 2.3
- **Accelerated study duration** : 90 days
- **Equivalent normal-storage time demonstrated :** ≈ 6 – 7 Months

Trend Stability Assessment Method

Trend stability was assessed by **comparing the rate of change between observation intervals** for key limiting parameters (moisture , peroxide value , free fatty acid , and sensory attributes), confirming no inflection , abnormal increase , or instability across the study duration.

Extrapolation Decision Rule

Shelf life beyond the demonstrated equivalent period was **predictively assessed** based on:

- stable parameter trends, internal alert limits remaining well below thresholds at the end of accelerated storage, and application of a **conservative internal extrapolation factor (laboratory decision rule) of 1.75×**, applied to the demonstrated equivalent normal-storage time.

Based on this correlation, the demonstrated equivalent period of approximately **6 – 7 Months**, when adjusted using the stated extrapolation factor, supports a **predictive shelf life assessment of approximately 10 – 12 Months (up to 12 Months maximum)**, subject to stated conditions.

Interpretation is aligned with:

- Food Safety and Standards Regulations (FSSAI).
- ICMSF guidance for low-moisture foods,
- Codex Alimentarius (for scientific guidance).
- Internal Validated ASLT SOP.

PARAMETERS EVALUATED

Physico-Chemical
Moisture, Water Activity (aw), Peroxide Value, Free Fatty Acid (As Oleic Acid)
Microbiological (Indicator Parameters)
Total Plate Count, Yeast & Mold
Sensory / Organoleptic
Appearance, Odour, Texture, Taste, Overall Acceptability

ACCEPTANCE CRITERIA (REFERENCE)

- **Water Activity :** aw ≤ 0.60

- **Microbiological Internal Acceptance Limits :**
  (guided by applicable FSSAI microbiological criteria framework)
  - Total Plate Count : ≤ 1.0 X 10^5 CFU / g
  - Yeast & Mold : ≤ 1.0 × 10^3 CFU / g

- **Physico-Chemical Internal Alert Limits :**
  - Peroxide Value : ≤ 10 meq O_2 / kg of extracted fat
  - Free Fatty Acid : ≤ 1.0 % as oleic acid (of extracted fat)

- **Sensory Acceptance :**
  Any objectionable off-odour, rancidity, unacceptable taste, or unacceptable overall acceptability constitutes failure / rejection.

RESULTS & OBSERVATIONS

A. PHYSICO-CHEMICAL PARAMETERS

Parameter	Unit	0 Day (04-11-2025)	45th Day (19-12-2025)	75th Day (18-01-2026)	90th Day (Final) (02-02-2026)	Test Method
Moisture	%	5.8	6.0	6.1	6.2	FSSAI Manual of Methods of Analysis of Foods – Cereals & Cereal Products
Water Activity (aw)	—	0.39	0.41	0.43	0.45	ISO 18787 : 2017
Peroxide Value	meq O_2 / kg (of extracted fat)	1.2	1.5	1.8	2.1	IS 548 (Part 1) : 1964
Free Fatty Acid (As Oleic Acid)	% (as oleic acid , of extracted fat)	0.28	0.31	0.33	0.36	IS 548 (Part 1) : 1964

Peroxide Value and Free Fatty Acid were determined on oil / fat extracted from the sample.
Results are expressed on extracted fat basis.

B. MICROBIOLOGICAL PARAMETERS (INDICATORS)

Parameter	Unit	0 Day (04-11-2025)	45th Day (19-12-2025)	75th Day (18-01-2026)	90th Day (Final) (02-02-2026)	Test Method
Total Plate Count	CFU / g	8.0 X 10^2	1.0 X 10^3	1.3 X 10^3	1.6 X 10^3	IS 5402 (Part 1) : 2012
Yeast & Mold	CFU / g	< 1.0 X 10^2	< 1.0 X 10^2	< 1.0 X 10^2	< 1.0 X 10^2	IS 5403 : 1999

C. SENSORY / ORGANOLEPTIC EVALUATION

Sensory evaluation was performed by a **semi-trained internal panel (n = 5)** using **defined acceptability descriptors aligned to internal sensory acceptance criteria**.

Attribute	0 Day (04-11-2025)	45th Day (19-12-2025)	75th Day (18-01-2026)	90th Day (Final) (02-02-2026)
Appearance	Acceptable	Acceptable	Acceptable	Acceptable
Odour	Normal	Normal	Normal	Normal
Texture	Acceptable	Acceptable	Acceptable	Acceptable
Taste	Normal	Normal	Acceptable	Acceptable
Overall Acceptability	Acceptable	Acceptable	Acceptable	Acceptable

RESULT INTERPRETATION

Water activity remained below the critical threshold for shelf-stable low-moisture foods throughout the study.
Physico-chemical parameters showed controlled and acceptable trends and remained well below internal alert limits.
Microbiological indicator counts remained within internal acceptance limits guided by the FSSAI framework.
Sensory attributes remained acceptable up to the final observation.

CONCLUSION

Based on the Accelerated Shelf Life Study conducted under defined storage conditions, **MAKHANA (Fox Nuts)** demonstrated acceptable stability trends over the study period.

Using Q10-based correlation , demonstrated equivalent stability of **approximately 6 – 7 Months** under normal storage conditions was established. Application of a conservative internal **extrapolation factor of 1.75X , combined with stable parameter trends and wide margin below alert limits , supports a predictive shelf life assessment of approximately 10 – 12 Months (Up To 12 Months Maximum) ,** when stored in sealed , Food – Grade packaging under recommended normal storage conditions. Confirmation by real-time storage study may be undertaken if required.

REMARKS

Shelf life estimation is predictive in nature and applicable only to the tested sample.
Results are valid only for the specified packaging and storage conditions.
Deviation in storage, handling, or packaging integrity may affect product stability.

END REPORT

Tested By

TYCONLAB ENGINEERING PVT. LTD. Authorised Signatory FARIDABAD

Issued & Approved By

National Accreditation Board for Testing and Calibration Laboratories

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for its facilities at

PLOT NO.: 361, 362, SAMAYPUR COLONY, FARIDABAD, HARYANA, INDIA

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Name of Legal Entity: TYCONLAB ENGINEERING PRIVATE LIMITED

Signed for and on behalf of NABL

Anita Rani
Director

N. Venkateswaran
Chief Executive Officer