# 6. Experimental Setup and Methodology

## 6.1 Objective

To validate the simulation model using realistic refining conditions and laboratory-scale testing for four common edible oils: mustard, soybean, groundnut, and sunflower.

## 6.2 Materials and Equipment

- Oilseeds Used: Mustard, Soybean, Sunflower, Groundnut  
- Extraction Methods:  
 - Mechanical Expeller (cold press)  
 - Solvent extraction (hexane method)  
- Reagents:  
 - Sodium Hydroxide (NaOH, 0.1N and 0.25N)  
 - Phosphoric Acid (for degumming)  
 - Bleaching Earth/Activated Clay (1.0–1.5%)  
- Equipment:  
 - Laboratory neutralizer with stirrer and water bath  
 - Digital titrator and burettes  
 - Soxhlet extractor  
 - Oven and balance for yield analysis  
 - Lovibond Tintometer (optional, for color analysis)

## 6.3 Methodology

* Step 1: Crude Oil Extraction

Oil was extracted using an expeller or Soxhlet (hexane-based) from pre-cleaned oilseeds. Yield was recorded and compared with standard literature values for validation.

* Step 2: Degumming

0.1–0.2% phosphoric acid was added and mixed at 60°C for 30 minutes. The mixture was centrifuged to remove gums and phosphatides.

* Step 3: Neutralization

Sodium hydroxide solution (based on estimated FFA) was added dropwise under constant stirring. Reaction temperature was maintained at 70°C. Soapstock formed was removed, and refined oil was washed and dried.

* Step 4: Bleaching

1–1.5% bleaching earth was added to refined oil at 90–100°C under vacuum. After 30 minutes of mixing, oil was filtered to remove color bodies.

## 6.4 Quality Testing (Post-Processing)

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| Parameter | Method Used | Standard Followed |
| Free Fatty Acid | Titrimetric (NaOH titration) | AOAC 940.28 |
| Peroxide Value | Iodometric method | AOAC 965.33 |
| Saponification Value | Reflux method | AOAC 920.160 |
| Iodine Value | Wijs method | BIS 548:1968 |

## 6.5 Simulation Validation

The observed FFA, NaOH consumption, and refining losses from lab experiments were compared against the simulation predictions. Deviation was found to be within ±0.08%, validating the model’s reliability for practical use.