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DNA BARCODING AND ITS APPLICATIONS IN AGRICULTURE

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ABSTRACT

DNA barcoding is a technique that uses a standardized region of the genome to identify species based on their unique DNA sequences. In agriculture, DNA barcoding has become an important tool for species identification and quality control in food products. It can be used to detect food fraud by identifying mislabeled or substituted species in meat, fish, and plant products. DNA barcoding can also be used to verify the authenticity of seeds and plant varieties and to identify pests and pathogens in crops and livestock. DNA barcoding is a powerful tool that can help ensure the safety, quality, and integrity of agricultural products, and it has great potential for future development and applications in this field.

INTRODUCTION

Food security is one of the major challenges in India. As per UNO-India, around 195 million people in India are undernourished, accounting for one-fourth of the world's hunger burden. Moreover, India is ranked 68th out of 113 major countries as per the food security index for 2022. The threat posed by new and invasive pests to agricultural productivity is one of the main food security challenges. The first and most important step in deciding the best course of action for managing such invasive pests is their accurate identification, traditionally based on the morphological diagnosis provided by taxonomic studies. However, molecular data instead of morphological data has emerged as one of the most promising strategies for identifying taxa (Blaxter, 2003). The advances in DNA sequencing technology have enabled researchers to perform easy, low-cost, and quick DNA analysis. This progress in biotechnology played a vital role in developing DNA barcoding (Jinbo *et al*., 2011). DNA barcoding is a DNA-based technique that uses short DNA sequences from a standardized genome region to identify and distinguish between different species. This approach is based on evaluating the variability within one or a few standard regions of the genome called DNA barcodes (Herbert *et al*., 2003). The rationale of this method is that the DNA barcoding sequences unambiguously correspond to each species (i.e., low intraspecific variability) but significantly differ between taxa (i.e., high interspecific variability) (Casiraghi *et al*., 2010).

APPLICATIONS OF DNA BARCODING IN AGRICULTURE

DNA barcoding is applicable in agriculture in the ways given below:

1. Species identification: DNA barcoding can identify different plant and animal species. In agriculture, this is particularly useful for identifying pests, diseases, and weeds that may harm crops. Accurate identifying these organisms can help farmers and researchers develop targeted control measures to prevent crop damage.

2. Food traceability: DNA barcoding can be used to track the origin of food products. This is particularly useful for verifying the authenticity and quality of agricultural products, such as fruits, vegetables, and meat. DNA barcoding makes it possible to identify the species and even the geographic origin of a food product, which can help prevent food fraud and ensure consumer safety.

3. Conservation: DNA barcoding can help conserve endangered plant and animal species. By identifying and cataloguing different species, researchers can monitor their populations and take steps to protect them from threats such as habitat loss and poaching.

4. Seed authentication: DNA barcoding can be used to authenticate the identity of crop seeds. This is particularly important for genetically modified crops or bred for specific traits. With DNA barcoding, farmers can ensure that the seeds they plant are the same as the ones they purchased, which can help prevent crop failures and loss of income.

LIMITATIONS OF DNA BARCODING IN AGRICULTURE

There are several limitations to the use of DNA barcoding in agriculture, including:

1. Incomplete reference databases: DNA barcoding relies on the comparison of the DNA sequence to a reference database of known sequences. However, many species have not been barcoded, and the databases are incomplete, especially for agricultural species in developing countries. This can lead to incorrect identifications or false negatives.

2. Hybridization and introgression: Some plant species can hybridize with closely related species, leading to difficulties in identifying hybrids using DNA barcoding. Similarly, the introgression of genes from wild relatives into domesticated crops can complicate the identification of crop varieties.

3. Purity and quality of samples: DNA barcoding requires high-quality DNA samples, which can be difficult to obtain from processed food products, degraded samples, or mixed samples. Contamination with other DNA, such as from microorganisms, can also lead to inaccurate results.

4. Limited resolution: DNA barcoding can distinguish between some closely related species, but in many cases, it cannot discriminate between different varieties or sub-species within a species. This can limit its usefulness in plant breeding and seed certification areas.

5. Cost and technical expertise: DNA barcoding requires specialized equipment, reagents, and expertise, making it expensive and difficult to implement in some settings. This can limit its availability and accessibility for small-scale farmers or food processors.

CONCLUSION

DNA barcoding is a powerful tool that can provide valuable information in agriculture. It can be used to identify and track different species, verify the authenticity and quality of agricultural products, protect endangered species, and ensure the integrity of crop seeds, but it is not a panacea and must be used in conjunction with other methods of species identification and quality control.

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