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Seed germination / phytotoxicity of end product fermentation of poultry farm waste

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Abstract
The present study was conducted in the Division of Livestock Production and Management, Faculty of Veterinary Sciences and Animal Husbandry (SKUAST- Kashmir) to assess the seed germination/phytoxicity of the fermented end product of poultry farm waste different seasons. Poultry farm waste in the form of poultry carcass (dead birds) and poultry litter was selected for this purpose. Nine treatment recipes formulated for fermentation were: T_1: Poultry carcass + Poultry litter, T_2:Poultry carcass + Poultry litter + *Lactobacillus* @ 1.0 per cent T_3:Poultry carcass + Poultry litter + *Lactobacillus* @ 0.5 per cent T_4: Poultry carcass + Poultry litter + Yeast @1.0 per cent T_5: Poultry carcass + Poultry litter + Yeast @ 0.5 per cent T_6: Poultry carcass + Poultry litter + *Lactobacillus* @ 1per cent + Yeast @ 0.5per cent T_7: Poultry carcass + Poultry litter + *Lactobacillus* @ 1per cent + Yeast @ 1per cent T_8: Poultry carcass + Poultry litter + *Lactobacillus* @ 0.5per cent + Yeast @ 0.5per cent T_9: Poultry carcass + Poultry litter + *Lactobacillus* @ 0.5per cent + Yeast @ 1 per cent. During winter season the significantly ($P \leq 0.05$) highest seed germination of 63.0 per cent was observed in T_2 and T_9 and lowest seed germination of 52 .0 per cent was observed in T_6 group. Similarly during summer season significantly ($P \leq 0.05$) highest and lowest seed germination of 64.5 and 52.5 per cent was observed respectively in T_9 and T_6 treatment groups. It was concluded that fermentation has significantly reduced the phytotoxic components of the poultry waste material.

Keywords: Fermentation, seed germination, poultry waste

1. Introduction
Intensive system of poultry rearing has resulted in the production large amount poultry waste in the form of dead birds and litter [1]. Disposal and utilization of such waste is the prime focus of modern day poultry production for maintaining of proper bio-security of livestock and humans [2]. Different disposal methods are used now-a-days for an effective management of the poultry waste, but have different types of issues associated with it [3]. Fermentation of poultry waste is one of the eco-friendly disposal methods used for utilization of poultry waste to yield a stable and matured end product [4]. Maturity of the final end product can be achieved with better seed germination and lower values of phytotoxic elements present in the end product [5]. Hence phytotoxicity or seed germination have inverse relationship for evaluating the suitability of end product to be utilized for agricultural purposes and to avoid environmental risks [6]. The objective of this study was to determine the phytotoxicity of the final product of the fermentation process by determining its seed germination per cent.

2. Materials and Methods
Fermentation of the poultry farm waste (dead birds and poultry litter) was carried out at Division of LPM under a roofed shed. The fermentation process was carried out in air tight plastic containers. Dead birds and poultry litter in 1:1 ratio was fermented in different combinations. Poultry waste was humidified with tap water in the proportion of 1:1 and the pH was adjusted to 6.5 with 50 % H_2SO_4 solution [7]. The different treatments recipes (three replicates in each treatment) having different levels of *Lactobacillus acidophilus* and Yeast (*Saccharomyces cerevisiae*) is shown in Table: 1. Dead birds and poultry litter was collected from local poultry farms. On the receipt of sufficient quantity of carcasses and poultry litter, the filling of fermentation containers was carried out uniformly. The finished fermented end product maturity was estimated by the seed germination percent as per the method of Huang [8].

Table 1: Treatment Combinations of Fermentation Experiment

Treatments	Description
Treatment 1	Dead birds + Poultry litter
Treatment 2	Dead birds + Poultry litter + lactobacillus @ 1.0 %
Treatment 3	Dead birds + Poultry litter + lactobacillus @ 0.5 %
Treatment 4	Dead birds + Poultry litter + Yeast @ 1.0 %
Treatment 5	Dead birds + Poultry litter + Yeast @ 0.5 %
Treatment 6	Dead birds + Poultry litter + Lactobacillus@ 1% + Yeast@ 0.5%
Treatment 7	Dead birds + Poultry litter + Lactobacillus @ 1% + Yeast @ 1%
Treatment 8	Dead birds + Poultry litter + Lactobacillus @ 0.5% + Yeast @ 0.5%
Treatment 9	Dead birds + Poultry litter + Lactobacillus@ 0.5%+ Yeast @1%

2.1 Statistical analysis
The data was statistically analyzed as per the methods suggested by Snedecor and Cochran [9]. SPSS software was used for comparing the means using one way ANOVA.

3. Results
During winter season the significantly ($P \leq 0.05$) highest seed germination of 63.0 per cent was observed in treatment groups T_2 (in which *Lactobacillus*@ 1% was added) and T_9 (in which *Lactobacillus*@ 0.5% and Yeast@ 1% was added) and lowest seed germination of 52 .0 per cent was observed in T_6 (in which *Lactobacillus*@ 1% and Yeast@ 0.5% was added). Similarly during summer season significantly ($P \leq 0.05$) highest and lowest seed germination of 64.5 and 52.5 per cent was observed respectively in T_9 and T_6 (Table. 2). The overall highest seed germination of 63.75 per cent was observed in T_9 treatment group (in which *Lactobacillus*@ 0.5% and Yeast@ 1% was added). There was no effect of different season on seed germination per cent in different treatments.

Table 2: Per cent seed germination due to fermentation during different seasons (Mean±SE).

Treatment	Winter	Summer	Overall
T_1	^{B}58.50±0.40	^{AB}58.00± 5.71	58.25± 0.20
T_2 (LB=1 %)	^{B}61.50±1.27 ^{a}	^{AB}55.50± 1.22 ^{b}	58.50± 2.44
T_3 (LB=0.5 %)	^{B}63.00± 1.62	^{AB}59.50± 1.22	61.25± 1.42
T_4 (Yeast =1 %)	^{B}58.50± 0.40	^{AB}61.00± 1.62	59.75± 1.01
T_5 (Yeast= 0.5 %)	^{B}61.50± 1.22	^{AB}62.50± 2.04	62.00± 0.40
T_6 (LB=1%+Yeast=0.5%)	^{A}52.00± 2.44	^{A}52.50± 0.20	52.25± 0.20
T_7 (LB= 1%+Yeast=1 %)	^{B}58.50± 0.40	^{AB}59.00± 1.62	58.75± 0.20
T_8 (LB=0.5+Yeast=0.5%)	^{B}61.50± 1.22	^{AB}59.50± 1.22	60.50± 0.81
T_9 (LB=0.5+Yeast=1%)	^{B}63.00± 1.62	^{B}64.50± 2.03	63.75±0.61

Figures with different small superscripts row wise and capital superscripts column wise differ significantly ($P<0.05$).

4. Discussion
Phytotoxins are compounds detrimental to plant growth and they come from agricultural use of pesticides, industrial solvents, propellants, and refrigerants degraded plastics [10]. Fermentation facilitates microbial degradation of organic molecules with phytotoxic properties, and in addition, organic matter generated through fermentation can bind phytotoxic metals and thereby reduce their bioavailability [11-12]. Seed germination of an organic fertilizer is an index of plant phytotoxicity and there is a reciprocal relationship between the two factors [13] hence more the seed germination lesser is phytotoxicity. Per cent seed germination of the end product of fermentation did not differ significantly ($P<0.05$) between different seasons (except for treatment groups T_2 and T_3. During winter and summer season the highest seed germination of 63.0 per cent was observed in treatment groups of $T_3$and T_9 and 64.5per cent in treatment group T_9 respectively (Table. 4.50). The overall highest seed germination of 63.75 per cent was observed in the treatment group T_9 (containing *Lactobacillus* @0.5 and Yeast@ 1 per cent) suggested the best combination of *Lactobacillus* and Yeast for seed germination. Earlier Dolor [14] observed similar results in the *Irvingia wombolu* (Vermoesen) seeds.

5. Conclusion
It was concluded that due to the presence of sufficient amount of *Lactobacillus acidophilus* and Yeast in the fermentation mixture has resulted in sufficient reduction of the phytotoxins and has led to an appreciable amount of seed germination per cent in the end product of fermentation. Hence a mature and secure final end product was attained.

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