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Bactericidal significance of aqueous extracts of *Jatropha tanjorensis* on *Salmonella* isolates from domestic chicken coops; Ayurveda and Universal *health coverage*

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Abstract

Multidrug resistance is more significant among other public health challenges in Nigeria. Many plants have been investigated to have antimicrobial effects on panels of microorganisms including multidrug-resistant pathogens. This study explored the antimicrobial potency of Jatropha tanjorensis on *Salmonella* isolates from domestic chicken coops. Wet and dried fecal samples of Chicken were obtained from chicken coops. Fecal samples and medicinal plants of interest were analyzed using standard microbiological techniques and procedures. The aqueous concentration of extracts from this research included 0.2 g-10 ml, 0.5 g-10 ml, 1 g-10 ml, 1.5 -10 ml, and 2 g-10 ml. Results of this study indicated that extracts of dried leaves showed more antimicrobial effects than fresh leaf extracts as significant zones of inhibition of 10 mm, 14 mm, 19 mm and 28 mm were observed for dried leaf extract concentrates of 0.5 g-10 ml, 1.0 g-10 ml, 1.5 -10 ml, and 2 g-10 ml respectively. Corresponding zones of inhibition of 9 mm, 11 mm and 20 mm were seen for fresh leaf extract concentrates of 1.0 g-10 ml 1.5 g-10 ml and 2.0 g-10 ml. Owing to their antimicrobial effectiveness, availability, and inexpensive qualities, traditional medicines should be integrated with allopathic medicines if Nigeria must achieve universal health coverage in Nigeria. Plant extracts possess extensive antimicrobial activities against many microorganisms. Hence, more plants' clinical toxicity and safety need to be investigated.

Keywords: Ayurveda; Domestic Chicken Coop; *Jatropha Tanjorensis*; Hospital Too Far; Phytochemical; *Salmonella*; Plant Extracts; Traditional Medicine; Universal Health Coverage

1 Introduction

Salmonella is a major food-borne pathogen that has been repeatedly linked to domestic chicken coops [1]. Domestic chicken coops are effective homemade chicken production facilities mainly for the purpose of enhancing family nutrition [2]. Sadly, the domestic chicken coop is a suitable habitat for pathogenic microorganisms such as *Escherichia coli, Campylobacter, Salmonella, Shigella,* and *Staphylococcus aureus* in the environment [3]. The significance of domestic chicken coops in the epidemiological pattern of communicable disease cannot be overemphasized. Children are most at risk of contracting infection caused by microbial contamination resulting from the environmental activities of chickens reared in domestic coops as they frequently present with gastroenteric symptoms and fever [2]. *Salmonella* specie is a gram-negative bacterium that is responsible for typhoid and paratyphoid fever as well as acute gastroenteritis [4]. *Salmonella* is treatable using antibiotics. However, instances of multidrug resistance by the pathogen have been documented [5].

The rising tides of antibiotic resistance by microorganisms continues to pose a substantial threat to achieving the basic objective of Universal health coverage of ensuring health care to all people in a given population irrespective of their financial strength [6, 7]. This is because patients now spend more time and resources managing their health thus,

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overwhelming available scarce resources and manpower [8]. There are fewer allopathic medical and health workers in Africa presently compared with numerous traditional medicine practitioners available [9]. If harnessed, traditional medicine can complement the efforts of allopathic medicine toward achieving Universal health coverage in Nigeria [10]. In India, over 100 of the 2500 discovered plant species have been approved for commercial purposes and mainstreamed into conventional medicine as remedies for various disease conditions. This has made India the largest producer of medicinal products of plant origin earning it the name "the botanical garden of the world" [11]. Traditional Medicine (TM) proffers remarkable potentials to combat antimicrobial resistance [12]. Herbal products show a wide spectrum of antimicrobial activities and thus are efficiently explored for managing diseases [13]. Despondently, there is a lingering unnecessary vilification between medical health workers and traditional medicine practitioners in Africa owing to claims of superiority [9]. This has decelerated the pace of integration of traditional medicine with conventional medicine toward ameliorating the health of individuals at a cost-effective rate as a core objective of achieving Universal Health Coverage [10]. The potential of antimicrobials of plant origin inhibiting the growth of *Salmonella* has been investigated by many studies.

Jatropha tanjorensis has gained culinary and therapeutic prominence over the years as it is used as a vegetable and remedy for basic illnesses [14]. The plant is characterized by its green coloration with over 80% moisture content. In Nigerian local parlance, it is known as "hospital too far" "Iyana-ipaja" and "Ugwu-Oyibo". Its therapeutic relevance in managing cases of malaria and hypertension has been documented owing to its phytochemical contents such as alkaloids, flavonoids, tannins, cardiac glycosides, saponins, and anthraquinones [15]. Furthermore, the effectiveness of *Jatropha tanjorensis* in enhancing the sexual prowess of men as well as the treatment of vaginal infection has been recognized [16]. Also, it has been opined to be an effective remedy for skin infections caused by *Staphylococcus aureus* [17]. Owing to these aforementioned potentials of Ugwu-oyibo together with the foreseen relevance of Ayurveda in achieving universal health coverage, this in vitro experiment aims to investigate the activities of the plant extracts against *Salmonella* pathogen isolated from the domestic chicken coop.

2 Methods

This current *in-vitro* study investigated the antimicrobial activity of *Jatropha tanjorensis* and was carried out at the Microbiology Laboratory of Federal University Wukari, Taraba State.

2.1 Medicinal plants collection

Jatropha tanjorensis leaves were obtained from Wukari Metropolis and were identified by a plant expert from the Department of Crop Production and Protection, Federal University Wukari, and immediately taken to the laboratory for further analysis using standard microbiological techniques and procedures.

2.2 Preparation of plant extracts

The extraction method used in this research was the hot water maceration technique. Following a thorough washing under running tap water and rinsing with distilled water, the collected *Jatropha tanjorensis* leaves were separated into two equal parts for purpose of achieving dried and fresh leave extracts. A part of the collected leaves was air-dried at room temperature under a shade for 7 days while the leftover leaves were immediately possessed. Following successive blending of the dried and fresh leaves, independent maceration in hot water was done for both leaves for a period of 3 days. A periodic rocking of the menstruum was done to enhance the extraction of important phytochemicals from the leaves. Following the separation of the extracts from the marc, extracts were further subjected to filtration. Hot water extracts of dried and fresh leaves were independently evaporated and various grams (0.2 g, 0.5 g, 1 g, 1.5 g 2 g) were singly dissolved in 10 ml of distilled water to obtain 0.2 g-10 ml, 0.5 g-10 ml, 1 g-10 ml, 1.5 -10 ml, and 2 g-10 ml concentrations.

2.3 Sterility test for plant extracts

Extracts obtained from evaporation were subjected to a sterility test for possible microbial contamination before subjecting it to an agar well diffusion procedure. 0.5 ml of each of the concentrates was pipetted into prepared sterile Sabouraud Dextrose Agar and incubated at 370c, overnight. Upon observation, the plates with the absence of visible growth indicated sterility.

2.4 Test microorganisms

A sterile container containing peptone water was used to independently obtain 1g of fecal samples from various domestic chicken coops in the Wukari metropolis and was immediately transferred to the laboratory for analysis. The peptone water helped to recover strained *Salmonella* cells. The pour plate technique was used to inoculate 1ml of each

sample into prepared Nutrient and MacConkey agar, respectively, and rocked gently to achieve a homogenous inoculation. Plates were incubated at 37°c overnight. Colonies from mixed cultures were sub-cultured in nutrient agar using the streak plate technique at 37°c for 24 hours to obtain pure isolates. Presumptive isolates were subjected to Gram staining and other biochemical tests for confirmation.

2.5 Antimicrobial activity of plant extracts

Pure isolates were inoculated into peptone broth and subjected to Agar well diffusion method. Using spread plate methods, 1ml of each of the inocula was spread uniformly on the surface of prepared Nutrient agar plates and labeled appropriately. Thereafter, a hole with a diameter of 7 mm was cut aseptically with a sterile cork borer, and 1 ml of the various concentrates of hot water extracts of *Jatropha tanjorensis* was introduced into the well. A growth inhibition pattern was observed following an overnight incubation at 370C. Agar well inoculated with water was considered as a negative test control.

3 Results

Extracts of dried and fresh leaves of *Jatropha tanjorensis* demonstrated enormous antimicrobial potential when screened for their bactericidal effects against *Salmonella* isolated from domestic chicken coops droppings.

Table 1 Biochemical identification of isolates

Isolate	Morphological Characteristic	Biochemical test						Gram stain
		CAT	INDO	MR	LAC	SUC	GLU	
Salmonella	Smooth, low convex, greyish white, and translucent	+	-	+	-	-	+	Negative bacilli

The morphological and biochemical characteristics of identified isolates are presented in Table 1, while Table 2 represents the growth inhibition pattern of the respective concentrations of extracts of fresh and dried leaves of *Jatropha tanjorensis* on *Salmonella*. A significant zone of growth inhibition of 10 mm, 14 mm, 19 mm, and 28 mm was observed for isolates subjected to 0.5 g-10 ml, 1.0g-10 ml, 1.5 g-10 ml, and 2.0 g-10 ml respective concentrations of dried leaves while No zone of Inhibition (NZI) was significant at 0.2g-10 ml and 0.5g-10 ml concentrations of dried extracts. Also, NZI was detected for fresh extract concentrates of 0.2g-10 ml, 0.5g-10, and 1.0g-10ml. However, a substantial microbial growth inhibition zone of 9 mm, 11 mm and 20 mm was significant for isolates subjected to 1.0 g-10 ml, 1.5 g-10 ml and 2.0 g-10 ml concentrations of fresh leave extracts. Heavy growth persisted for all negative control plates.

Table 2 Antimicrobial effects of extracts on isolates

Concentration	Jatropha tanjorensis	
	Fresh leaves	Dried leaves
0.2 g-10 ml	NZI	NZI
0.5 g-10 ml	NZI	10 mm
1.0 g-10 ml	9 mm	14 mm
1.5g-10 ml	11 mm	19 mm
2.0 g-10 ml	20 mm	28 mm

Key: NZI = No Zone of Inhibition, mm = millimetre, ml = millilitre, g = gram.

4 Discussion

The antimicrobial analysis of *Jatropha tanjorensis* extracts from this study has unearthed its effectiveness in inhibiting the growth of zoonotic *Salmonella* isolates from domestic chicken coops. Similarly, the effectiveness of *Jatropha tanjorensis* on clinical isolates of *Escherichia coli* has been documented by [14]. Also, Ajah *et al.,* [18] have recommended

leaves of *Jatropha tanjorensis* for the prevention of isoprenaline-induced renotoxicity based on its vital phytochemical contents namely alkanes, fatty acids, flavonoids, alkaloids, and amines. Phytochemicals that customarily provide protection to plants from harsh ecological circumstances possesses also have bactericidal abilities with the potential for use in healing diseases [19]. The use of plants with antimicrobial potential has increased tremendously recently. Traditional medicines are now being prioritized over allopathic medicine in achieving universal health coverage owing to their their cheap and ready availability, while the efforts of synthetic antibiotics use as remedies are limited successfully by multidrug resistance [9]. The possibilities of microorganisms inflicting resistant genes and mechanisms on antimicrobials of plant origins are slim because of their sophisticated molecular features [20]. Plant with antimicrobial potentials synthesizes secondary metabolites that provide protection against microbial resistance mechanism by infringing on intermediary metabolism and apoptosis [21] Also, plants can obstruct cellular "protein to protein" interfaces, thus activating effective modulators of signal transduction and immune response [22]. Nonetheless, the likelihood of microorganisms assuming resistance to antimicrobials of plant origins has been hinted at. This opinion has been aggressively disputed by [23] who recommended more research to substantiate the claim. Presumed resistance by microorganisms to antimicrobials of plant extracts may be due to unregulated activities of quacks and unskilled professionals who do not strictly follow the standard rudiments of phytochemical extracting processes as well as poor choices in identifying potential plants of medicinal value. This current study among its objectives was able to substantiate the disparity in the efficacy of extracts of fresh and dried leaves in inhibiting microbial growth. Dried leaf extracts were found to have more antimicrobial effects than extracts of fresh leaves even at a low concentration. The moisture content of fresh leaves has been found to enhance microbial survival and growth [24]. As stated earlier, *Jatropha tanjorensis* has a very high moisture content of over 80%

Contrary to the findings of [25], that ethanol extract more of the phytochemical contents of plants than any other solution, this current study proved that water at a high temperature can also extract the bioactive contents of plants which can significantly inhibit microbial growth. This finding is consistent with that of [26] who noted that hot water can extract a higher yield of phytochemical contents from plants than methanol. The deliberate choice of the aqueous extraction technique used in this study is not unconnected to its cheap and innocuous qualities in furtherance of the core concept of achieving Universal health coverage by ensuring people can have access to quality healthcare irrespective of their financial and social-economic capacity. Owing to its availability qualities, water is the more cost-efficient solvent used by traditional healers in the preparation of medicines from a varied spectrum of potential medicinal sources including plants [27]. However, the use of water is disadvantaged by its natural microbial contamination. If opportunities for traditional medicine are maximized, there will be better and more affordable health coverage. In India, over 90% of individuals rely on traditional medicine for their basic health needs [28]. In Nigeria, the ratio of traditional medicine practitioners to the population is 1: 110 while the ratio of medical doctors to the population is 1: 16,400 [9]. This ratio has proven that access to tradomedical practitioners is more practicable compared to conventional medicine practitioners. This goes a long way to explain that people particularly in Africa has more willingness to patronize the former than the latter owing to the socioeconomic impediments in most part of Africa.

5 Conclusion

Common communicable diseases from environmental contamination can be managed with antimicrobials of plant origin which is not only cost-effective but reduces the possibility of antimicrobial resistance. And unless traditional medicine is integrated with allopathic medicine, the efforts of achieving universal health coverage in Nigeria amidst the near absence of a workable and reliable health insurance scheme will be a mirage.

Compliance with ethical standards

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Disclosure of conflict of interest

The researcher declares no conflict of interests in this review.

Statement of ethical approval

The study was approved by the Review Board of Tropical disease Unit, Microbiology Department, Federal University Wukari. This research was conducted considering all ethical issues such as Justice, Beneficence, Non-Maleficence and Autonomy were considered when conducting the research.

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