International Journal of Home Science 2017; 3(1): 280-282

International Journal of Home Science

ISSN: 2395-7476
IJHS 2017; 3(1): 280-282

www.homesciencejournal.com
Received: 01-11-2016
Accepted: 02-12-2016

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Antimicrobial activity of fermented and non-fermented Oats (*Avena sativa*) against selected food borne pathogens

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Abstract
The present study was carried out to study the antimicrobial activity of non-fermented oats and oats fermented with *Lactobacillus acidophilus*. Oats have a distinctive nutritional profile compared with other types of grain, including protein, fibre, essential fatty acids, vitamins, minerals and antioxidants. In the this study fermented oats was found to exhibit a potent antimicrobial activity when tested with a food borne pathogens such as *E. coli*, *Salmonella typhi* and *Staphylococcus aureus*, whereas the non-fermented oats did not exhibit any antimicrobial activity.

Keywords: oats, fermentation, antimicrobial activity

1. Introduction
Oats is considered as one of the best cereals since it is a rich source of protein of high biological value, essential fatty acids, soluble fibre (beta-glucan) and insoluble fibre, micronutrient such as iron, potassium, copper, magnesium, thiamine, folate, zinc and phosphorus (Yu *et al*., 2012) [10]. Vitamin E, phytic acid, phenolic compounds, avenanthramides, flavonoids and sterols present in oats exhibit antioxidant activity. (Brindzova *et al*., 2012) [2].
Fermented foods are food substances that are invaded or overgrown by edible microorganisms whose enzymes, particularly amylases, proteases, lipase, hydrolyse the polysaccharides, proteins and lipids respectively to non-toxic products with flavours, aroma and texture pleasant and attractive to the human consumer (Lee, 2003) [5]. One of the key claims for the health benefits of fermentation is their contribution of live microbes to the existing colonies of the gut (Foroutan, 2012) [3].
Probiotics are 'live microorganisms which when administered in adequate amounts confer health benefits to the host' (WHO, 2015-2016) [9]. Probiotics can be considered functional foods because they provide health benefits beyond the traditional nutritional function (Lin, 2003) [6]. There is increasing evidence in favour of the claims of beneficial effects attributed to probiotics, including improvement of intestinal health, enhancement of the immune response, reduction of serum cholesterol, and cancer prevention (Roos and Katan, 2000) [7].

2. Materials and Methods
Oats purchased from supermarket was cleaned to remove the impurities present in them. Then this was ground to a fine powder using a food processor.
1 gm of oats was mixed with 50ml of water in the ratio of 1:50 and it was autoclaved for 45 minutes. The same procedure was carried out for fermented oats to which 100µl of *Lactobacillus acidophilus* was added. Then the conical flask was plugged with cotton to keep insects and flies away. Fermentation was carried out for a period of 72 hours at room temperature.

Antimicrobial activity
The antimicrobial tests were performed using agar disk diffusion method described by Bauer *et al*. (1966) [1]. The Muller Hinton agar was prepared and left to cool at 45 °C. Agar plates were prepared using sterile nutrient agar.

The bacterial inoculum was evenly spread over the surface of the agar plates using sterile cotton swabs. Whatman filter paper was punched by using a punching machine and it was sterilized. The Samples were added slowly to the disks at different concentrations (20µl, 25µl and 30µl). Disks were allowed to dry for 10 minutes. After that, these disks were placed on individual agar plates and incubated at 37 °C for 24 hours. The plates were observed for the presence of a clear zone around the well. The presence of a clear zone indicated the presence of antimicrobial activity.

3. Result and Discussion

The antimicrobial property of fermented oats and non-fermented oats were detected using the agar disk diffusion methods against *E.coli*, *Salmonella typhi* and *Staphylococcus aureus* at 20µl, 25µl and 30µl.

Table 1: Antimicrobial activity of fermented and non-fermented oats Samples exhibited against *E. Coli, Salmonella typhi and Staphylococcus aureus*

Pathogens	Sample	Zone of inhibition (mm)		
		20µl	25µl	30µl
E.coli	Fermented oats	16	18	20
	Non-fermented oats	0	0	0
Salmonella typhi	Fermented oats	0	5	8
	Non-fermented oats	0	0	0
Staphylococcus aureus	Fermented oats	0	6	7
	Non-fermented oats	0	0	0

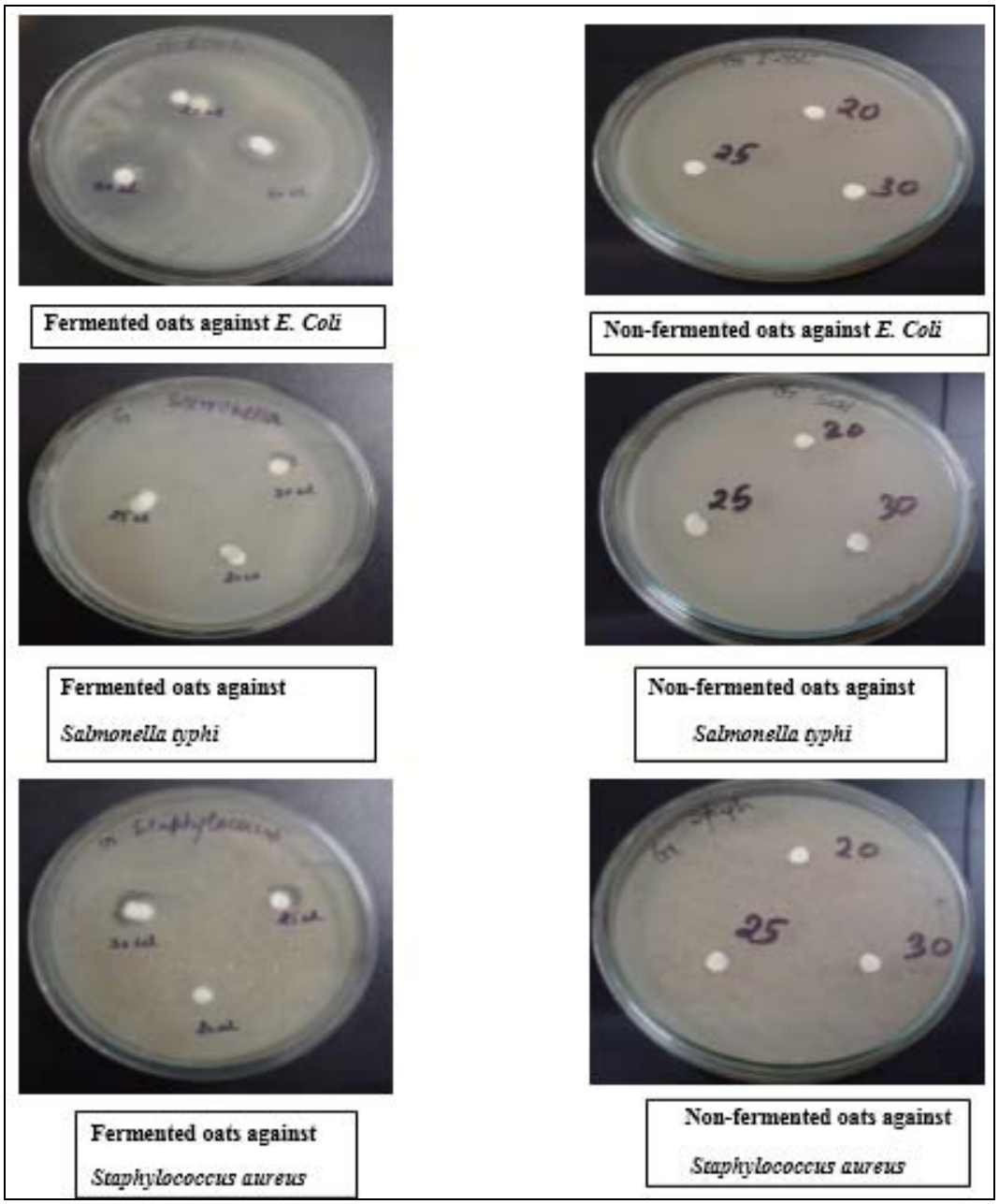

Fig 1: Antimicrobial activity of fermented and non-fermented oats against selected food borne pathogens

From table 1, it is evident that fermented oats had significant antimicrobial activity against *E. coli, Salmonella typhi and Staphylococcus aureus.* The results indicated that the inhibitory activity of fermented oats was dose dependent. Whereas non-fermented oats did not exhibit antimicrobial activity. When the concentration of the sample increased, a concomitant increase in the diameter of zone of inhibition was observed. A diameter with zone of inhibition of 10 or less indicates low antimicrobial activity, a diameter zone of inhibition from 11 to 15 indicates an intermediate antimicrobial activity, a diameter with a zone of inhibition of 16 or more indicates a high antimicrobial activity against the test microorganisms (pathogens) (Johnson and Case, 1995) [4].

Antimicrobial activity of oats may be due to the phenolic compounds present in it. The site and number of hydroxyl groups on the phenols are responsible for toxicity to microorganism. Phenolic toxicity against microorganism causes membrane disruption, binding or adhesion making complex with cell wall and inactivation of enzymes in microorganisms (Salim *et al*., 2014) [8].

4. Conclusion

The present study conclusively demonstrates the antimicrobial activity of fermented oats against selected food borne pathogens when compared to non-fermented oats. Fermented oats when supplemented in the diet can serve as a potential probiotic food and help in maintaining good gastrointestinal health.

5. Acknowledgement

I would like to extend my sincere thanks to the Women's Christian College management for providing me with a research grant which helped in the successful completion of this project.

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