CURRENT TRENDS IN MULTIDISCIPLINARY SCIENCES VOLUME - III

By

Dr. Bhavinkumar R. Chavda

Teaching Assisstant, Sadar Vallabhbhai National Institute of Technology (SVNIT), Surat, Gujarat, India.

SOUTH ASIAN
ACADEMIC PUBLICATIONS

Published By:
South Asian Academic Publications
3-37, Dirisavancha, Kanigiri, Prakasm District
Andhra Pradesh-523445 India
Phone No. -9441545787, 9959049730
Email- saapbooks@gmail.com

Chief Editor: Dr. Bhavinkumar R. Chavda

The author/publisher has attempted to trace and acknowledge the materials reproduced in this publication and apologize if permission and acknowledgements to publish in this form have not been given. If any material has not been acknowledged please write and let us know so that we may rectify it.

© South Asian Academic Publications

Publication Year: 2021

Pages: 1-84

ISBN: 978-93-92153-15-0

Price: Rs. 350 INR.

CONTENTS

EVOLUTIONARY CONTROL SCHEME FOR SENSOR LESS VECTOR CONTROL OF INDUCTION MOTOR

Dr. G.SRINIVAS
Assistant Professor
GITAM (Deemed To Be University)
Hyderabad

Abstract

This paper deals with the control of induction motor by tuning the PI controller parameters by using Particle swarm optimisation (PSO) technique. The response of the induction motor for performance characteristics like speed , torque, flux ,speed error and flux error for various loads like 6Nm and 4Nm with the parameters like peak overshoot and peak time are compared with conventional PI controller and PSO tuned PI controller.

Keywords: *Induction motor (IM), conventional controllers, sensor less vector control, PI Controller PSO controller.*

Introduction

Particle Swarm Optimisation Concepts And Their Applications

There is no known single optimization method available for solving all optimization problems. A lot of optimization methods have been developed for solving different types of optimization problems in recent years. The modern optimization methods (sometimes called non-traditional optimization methods) are very powerful and popular methods for solving complex engineering problems. These methods are particle swarm optimization algorithm, neural networks, genetic algorithms, ant colony optimization, artificial immune systems, and fuzzy optimization.

The Particle Swarm Optimization algorithm (abbreviated as PSO) is a novel population-based stochastic search algorithm and an alternative solution to the complex non-linear optimization problem. The PSO algorithm was first introduced by Dr. Kennedy and Dr. Eberhart in 1995 and its basic idea was originally inspired by simulation of the social behaviour of animals such as bird flocking, fish schooling and so on. It is based on the natural process of group communication to share individual knowledge when a group of birds or insects search food or migrate and so forth in a searching space, although all birds or insects do not know where the best position is [1]. But from the nature of the social behaviour, if any member can find out a desirable path to go, the rest of the members will follow quickly.

In PSO, each member of the population is called a particle and the population is called a swarm. Starting with a randomly initialized population and moving in randomly chosen directions, each particle goes through 3 the searching space and remembers the best previous positions of itself and its neighbours. Particles of a swarm communicate good positions to each other as well as dynamically adjust their own position and velocity derived from the best position of all particles. The next step begins when all particles have been moved. Finally, all particles tend to fly towards better and better positions over the searching process until the swarm move to close to an optimum of the fitness function [2].

The PSO method is becoming very popular because of its simplicity of implementation as well as ability to swiftly converge to a good solution. It does not require any gradient information of the function to be optimized and uses only primitive mathematical operators. As compared with other optimization methods, it is faster, cheaper and more efficient.

In addition, there are few parameters to adjust in PSO. That's why PSO is an ideal optimization problem solver in optimization problems. PSO is well suited to solve the non-linear, non-convex, continuous, discrete, integer variable type problems.

Swarm intelligence (SI) is based on the collective behaviour of decentralized, self-organized systems. It may be natural or artificial. Natural examples of SI are ant colonies, fish schooling, bird flocking, bee swarming and so on. Besides multi robot systems, some computer program for tackling optimization and data analysis problems are examples for some human artifacts of SI. The most successful swarm intelligence techniques are Particle Swarm Optimization (PSO) and Ant Colony Optimization (ACO). In PSO, each particle flies through the multidimensional space and adjusts its position in every step with its own experience and that of peers toward an optimum solution by the entire swarm. Therefore, the PSO algorithm is a member of Swarm Intelligence.

PSO Algorithm Parameters:

There are some parameters in PSO algorithm that may affect its performance. For any given optimization problem, some of these parameter's values and choices have large impact on the efficiency of the PSO method, and other parameters have small or no effect. The basic PSO parameters are swarm size or number of particles, number of iterations, velocity components, and acceleration coefficients illustrated bellow. In addition, PSO is also influenced by inertia weight, velocity clamping, and velocity constriction.

Swarm Size:

Swarm size or population size is the number of particles n in the swarm. A big swarm generates larger parts of the search space to be covered per iteration. A large number of particles may reduce the number of iterations need to obtain a good optimization result. In contrast, huge amounts of particles increase the computational complexity per iteration, and more time consuming. From a number of empirical studies, it has been shown that most of the PSO implementations use an interval of 20 to 60 size.

Iteration Numbers:

The number of iterations to obtain a good result is also problem-dependent. A too low number of iterations may stop the search process prematurely, while too large iterations has the consequence of unnecessary added computational complexity and more time needed.

Velocity Components:

The velocity components are very important for updating particle's velocity. There are three terms of the particle's velocity in equations:

The term V_{if} is called inertia component that provides a memory of the previous flight direction that means movement in the immediate past. This component represents as a momentum which prevents to drastically change the direction of the particles and to bias towards the current direction.

The term $c_1 r_{1j}^t \left[P_{best,i}^t - x_{ij}^t \right]$ is called cognitive component which measures the performance of the particles relative to past performances. This component looks like an individual

memory of the position that was the best for the particle. The effect of the cognitive component represents the tendency of individuals to return to positions that satisfied them most in the past. The cognitive component referred to as the nostalgia of the particle.

The $c_2 r_{2j}^t [\, G_{best} - x_{ij}^t]$ for *gbest* PSO or $c_2 r_{2j}^t [\, L_{best,i} - x_{ij}^t]$ term for l best PSO is called social component which measures the performance of the particles relative to a group of particles or neighbours. The social component's effect is that each particle flies towards the best position found by the particle's neighbourhood

Acceleration coefficients:.

The acceleration coefficients and, together with the random values and , maintain the stochastic influence of the cognitive and social components of the particle's velocity respectively. The constant expresses how much confidence a particle has in itself, while expresses how much confidence a particle has in its neighbours [3].

Advantages and Disadvantages of PSO:

It is said that PSO algorithm is the one of the most powerful methods for solving the non-smooth global optimization problems while there are some disadvantages of the PSO algorithm. The advantages and disadvantages of PSO are discussed below [4]:

Advantages of the PSO algorithm:

1) PSO algorithm is a derivative-free algorithm.
2) It is easy to implementation, so it can be applied both in scientific research and engineering problems.

3) It has a limited number of parameters and the impact of parameters to the solutions is small compared to other optimization techniques.
4) The calculation in PSO algorithm is very simple.
5) There are some techniques which ensure convergence and the optimum value of the problem calculates easily within a short time.
6) PSO is less dependent of a set of initial points than other optimization techniques.
7) It is conceptually very simple.

Disadvantages of the PSO algorithm:

1) PSO algorithm suffers from the partial optimism, which degrades the regulation of its speed and direction.
2) Problems with non-coordinate system (for instance, in the energy field) exit.

In the present scenario, evolutionary methods such as PSO are very well known for tuning the parameters [4]. The evolutionary methods can efficiently solve the complex issues related to speed tracking, where the conventional schemes are not readily capable of optimizing the controller parameter. [4].

Many researchers [5] revealed that the PSO scheme emerged as a valuable tool for Sensorless control schemes. They carried out a comparative analysis and found that the PSO scheme yields the optimal solution [6]. On the other hand, to realize the experimental setup, the controller implementation for the generation of the PWM signals plays a critical role in getting the achieved response of the SVC-IM.

The variables in PSO can take any values based on their current position in the particle space and the corresponding velocity vector. Genetic algorithms do not efficiently handle complexity, because in such cases, the number of elements undergoing mutation is vast, which causes a considerable increase in the search space. So, in this case, PSO is the best alternative as it requires a small number of parameters and a correspondingly lower number of iterations. Furthermore, GA usually converges towards a local optimum or even arbitrary points rather than the global optimum of the problem, while PSO tries to find the global optima.

Yamilledel Valle et al. [4] described the basic concepts of PSO and its numerous variants in different optimization problems. Also, a review of PSO applications in power systems-based optimization problems gives the reader some insight into how PSO can serve as a solution to some of the most complicated engineering optimization problems discussed.

Particle Swarm Optimization (PSO) approaches

Particle swarm optimization (PSO) relies on population-based stochastic optimization, where the intelligence of swarms works for solving problems. The PSO has many similarities with evolutionary computation techniques such as genetic algorithms. However, the features of PSO, like an easy way of implementation, stable convergence characteristics, and computational efficiency, have made it much superior to others [9]. PSO approach relies on the evolutionary concept of birds flocking. It comprises the number of agents called population moving around a space to find the solution path. PSO does not involve the process of selection, cross-over, and fitness evaluation as that in GA's [4].

In this approach, all particles are points in an N-dimensional space and participate until the end of the process.

Each particle tries to move towards the optimal path by adjusting its current velocity and position concerning itself and by comparing with neighbouring particles also and keeps a record of the best value attained individually called P_{best} and best value attained by any neighboring particle called g_{best} [5].

The approach lies in accelerating each particle by a random weight based on constraints of current position and velocity, the distance between the current value of position and P_{best} position and the current value of position and g_{best} position. The position of the particle gets modified according to the mathematical approach. The weights get incremented if the iteration number is less than the defined number of defined iterations. The convergence process terminates when all iterations complete and the best values attained are optimal values.

1.1Tuning of PI Controller by incorporating with PSO for SVC-IM

PSO involves less no. of operations like velocity and position updating. It requires more no. of iterations and computational time. The obtained values (K_P and K_i) control the SVC-IM for tuning of PI controller. The estimation of load torque by tuning of PI controller by employing PSO application SVCIM is shown in Fig 01.

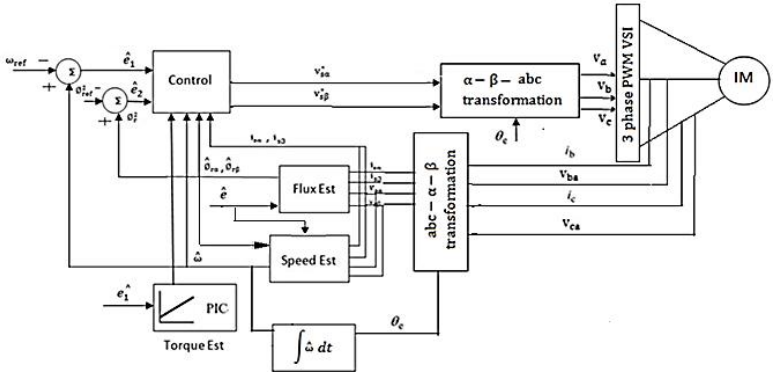


Figure 01: PSO-based control scheme for SVC-IM.

In this module, the control of SVC-IM is by the PI controller whose parameters i.e. K_p and K_i values involve the PSO approach. The block diagram shown in Fig 02 illustrates the mode of Control by PSO.

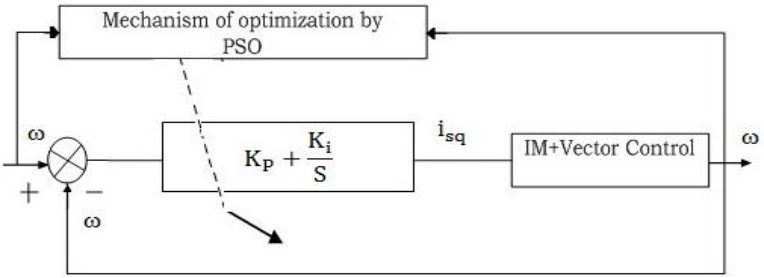


Figure 02: PSO-based control scheme for SVC-IM.

The control criteria depend on the adjustment of weights to obtain the optimal path by accelerating the particle towards P_{best} and g_{best} location. The adjustment of the particle's location lies in the following steps. At every point, the velocity of the particle is updated, taking into factors like current velocity and position, the distance between current velocity and P_{best} and distance between current velocity andg_{best}. The mechanism for PSO optimization is as follows in the below steps:

The following notations update the weights, velocity, and position of the particles in the above equations:

W_{Min} = initial weight;

W_{Max} = final weight;

k = iteration number, initially k=1;

max iter = maximum iteration number;

Iter = current iteration number.

v_i^k: velocity of agent i at iteration k;

W: weighting function;

$C_{i:}$ weighting factor;

rand: defined as a uniformly distributed random number between 0 and 1;

P_{besti} : P_{best} of particle i;

g_{besti} : g_{best} of the group.

S_i^{K+1} = current position of the particle at k+1th iteration

S_i^K = position of the particle at kth iteration

v_i^{K+1}= velocity of particle at (k+1)th iteration

Step 1: Initialize $K_p$and K_i values by Z-N method and set parameters w_{Min} ,w_{Max} , C1 and C_2

Step 2: Generate population size20 by selecting K_p and $K_i$values in the boundaries specified by values obtained in the conventional PI controller.

Step 3: Calculate the fitness of particle F_i^k= f(X_{ik}) for all values and find the index of best particle b. If the error is within tolerable limits, stop and declare particle b values as optimal values. Else go to step 4.

Step 4: Select $P_{best\ i}^k = x_i^k$ and $g_{best\ i}^k = x_b^k$ initially. The following weighting function given by the equation updates the velocity:

$$W = W_{max} - k \frac{[(W_{Max} - W_{Min}) \ X \ iter]}{max \ Iter} \qquad (1)$$

Step 5: The velocity gets updated by P_{best} and g_{best} values given by expressions (2.109) and using the velocity obtained in the above expression position of the particle is updated as given by equation 1. $v_i^{K+1} = v_i^k + C_1 rand_1(\ldots)X(p_{best} - S_i^k) + C_2 rand_2(\ldots)X(g_{best} - S_i^k)$ (2)

$S_i^{K+1} = S_i^K + v_i^{K+1}$ (3)

Step 6: Evaluate the fitness of the particle (using fitness function square of error as in GA) and find the fittest particle.

Step 7: Check for the number of generations. If the generation value is more than the maximum of defined generations, then terminate and declare the least error population as optimal values.

The final values obtained after the application of the PSO technique are optimal values of PI controller parameters used for simulation of the SVCIM.

Analysis for Load torque estimation by PSO tuned PI Controller for a load of 6Nm.

The analysis of SVCIM by PSO tuned PI controller for a load torque of 6Nm for reference and estimated torque, reference and estimated speed ,speed error , reference and estimated flux shown in Figure 3 to Figure 7.

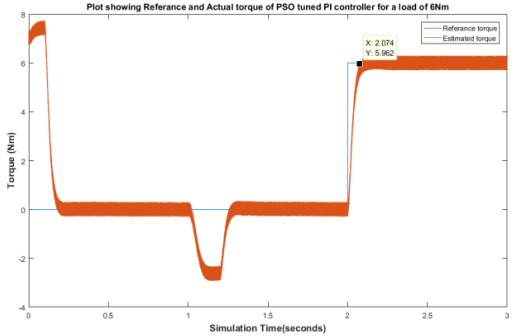


Fig 03.: Plot for reference and actual torque of PSO tuned PI controller for a load of 6Nm.

The plot of reference and estimated torque of the PSO tuned PI controller for a load of 6Nm is shown in Fig 03. The peak overshoot of torque is 7.598 Nm at a time corresponding to 0.098 seconds and torque dips to a value of 2.686 Nm at a time corresponding to 1.159 seconds. The torque settles at a value of 5.692 Nm for a load of 6 Nm at a time period of 2.074 seconds.

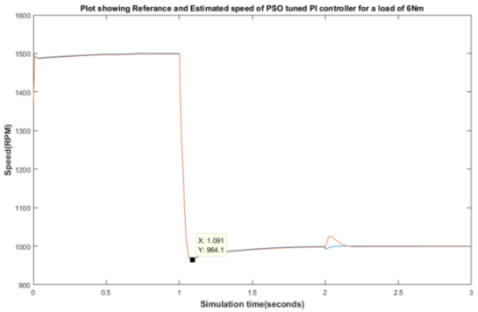


Fig 04. Plot for reference and estimated speed of PSO tuned PI controller for a load of 6Nm.

The plot of reference and estimated speed of PSO tuned PI controller for a load of 6Nm is shown in Fi 04. The peak overshoot for speed is 1495 rpm, corresponding to 0.00775 seconds for a reference range of 1500 rpm and dips to a value of 964 rpm corresponding to 1.076 seconds. Since peak overshoot and dip in speed are less than GA tuned PI controller, it shows that PSO tuned PI controller gives better results.

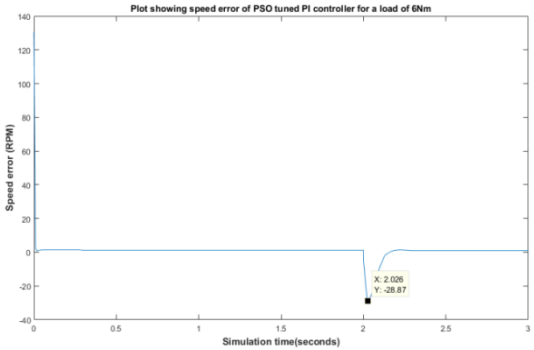


Fig 05: Plot for speed error of PSO tuned PI controller for a load of 6Nm.

The Plot for speed error of PSO tuned PI controller for a load of 6Nm is shown in Fig 05. The speed error dips to a value of 28.87 rpm at a time corresponding to 2.026 seconds.

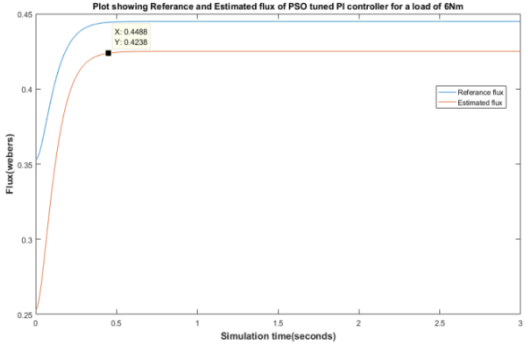


Figure6.: Plot for reference and estimated flux of PSO tuned PI controller for a load of 6Nm.

The plot of reference and estimated flux for the PSO tuned PI controller shown in Figure 6. The reference flux attains a peak value of 0.4435 webers at a time corresponding to 0.3873 seconds and the estimated flux attains a peak value of 0.4238 webers at a time corresponding to 0.4488 seconds.

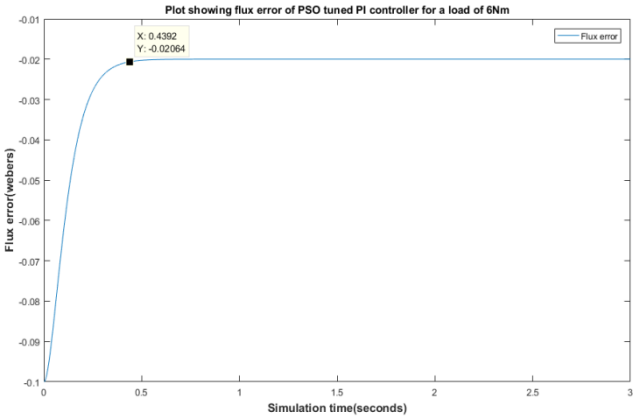


Fig 07.: Plot for flux error of PSO tuned PI controller for a load of 6Nm.

The plot of flux error for the PSO tuned PI controller for a load of 6Nm is shown in Figure7. The flux error attains a peak value of 20.64 milli webers at a time corresponding to 0.4392 seconds. The response for various parameters in terms of peak overshoot and peak time for a load of 6Nm is shown in Table 01.

Table 01:

Response for speed and torque in terms of peak overshoot (M_p) and peak time (t_p) for Load torque estimation by PSO tuned PI controller for a load of 6Nm

Speed(rpm)	964	1.092
Speed error(rpm)	24.94	2.025
Torque(N-m)	7.665	0.089
Estimated flux(webers)	0.4324	0.4108
Flux error (webers)	0.01042	0.4772

3.7.1 Analysis for Load torque estimation by PSO tuned PI Controller for a load of 4Nm.

The analysis of SVCIM by PSO tuned PI controller for a load torque of 4Nm for reference and estimated torque, reference and estimated speed ,speed error , reference and estimated flux shown in Figure 8 to Figure12.

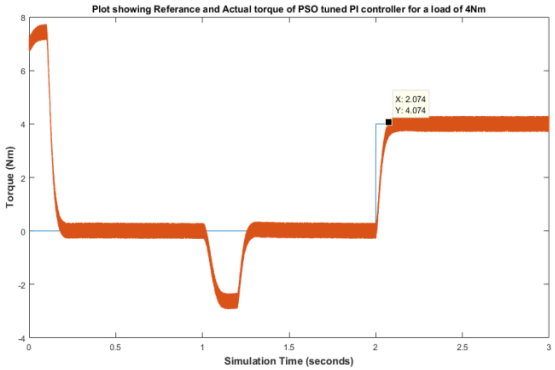


Fig 08.: Plot for reference and actual torque of PSO tuned PI controller for a load of 4Nm.

The plot of Reference and actual torque of PSO tuned PI controller for a load of 4 Nm is shown in Fig 08. The peak overshoot for torque is 7.678 Nm at a time corresponding to 0.1018 seconds. The dip in torque is 2.796 Nm at a time corresponding to 1.159 seconds. The torque settles at a constant value of 4.074 Nm against a reference value of 4Nm at a time period of 2.074 seconds.

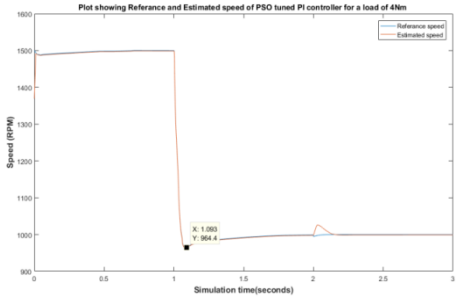


Fig 09. : Plot for reference and actual speed of PSO tuned PI controller for a load of 4Nm.

The plot of reference and estimated speed of the PSO tuned PI controller for a load of 4Nm is shown in Fig 09. The peak overshoot for speed is 1497 rpm at a time corresponding to 0.0045 seconds against a reference speed of 1500 rpm and the dip in speed is 964.1rpm against a reference speed of 100 rpm at a time corresponding to 01.093 seconds.

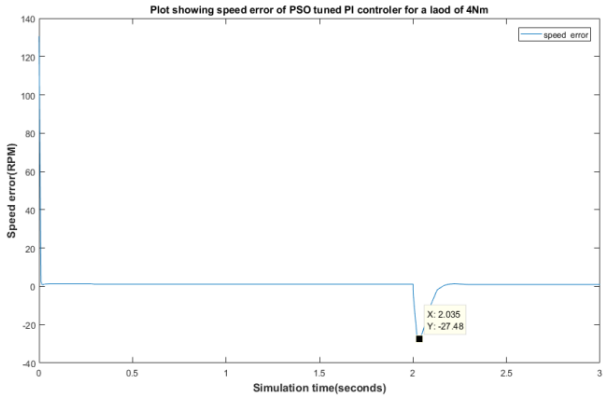


Fig 10. : Plot for speed error of PSO tuned PI controller for a load of 4Nm.

The Plot for flux error of PSO tuned PI controller for a load of 4Nm is shown in Fig 10. The flux error attains a peak value of 20.63 milli webers at a time corresponding to 0.4201

seconds. The response for various parameters in terms of peak overshoot and peak time for a load of 4Nm is shown in Table 2.

Table 02:

Response for speed and torque in terms of peak overshoot (M_p) and peak time (t_p) for Load torque estimation by PSO tuned PI controller for a load of 4Nm.

Parameter	**Peak overshoot(M_p)**	**Peak time(t_p) (seconds)**
Speed(rpm)	964	1.093
Speed error(rpm)	27.48	2.025
Torque(N-m)	0.4235	0.4329
Estimated flux(webers)	4.074	2.079
Flux error (webers)	0.02083	0.429

Conclusion

Finally, the values of peak overshoot and the peak time for speed and torque response of evolutionary methods, i.e., PSO is least of all the methods hence can be considered to give better performance compared to conventional and artificial methods. PSO involves only velocity and position updating of P_{best} and g_{best} values, the computational time, memory allocation, and no of iterations involved in PSO computation is least. Since for better performance, the peak time and peak overshoot should be lesser. Hence it can be finally concluded that the PSO methods are best of all methods considered.

References

1. Dian Palupi Rini, Siti Mariyam Shamsuddin and Siti Sophiyati Yuhaniz "Particle Swarm Optimization:

Technique, System and Challenges" International Journal of Computer Applications Volume 14– No.1, January 2011.

2. Radoslav Harman "A very brief introduction to particle swarm optimization" Department of Applied Mathematics and Statistics, Faculty of Mathematics, Physics and Informatics Comenius University in Bratislava
3. Qinghai Bai "Analysis of Particle Swarm Optimization Algorithm" computer and information science volume 3 Issue 1 February 2010.
4. "Russell Eberhart New Optimizer Using Particle Swarm Theory", Purdue School of Engineering and Technology Indianapolis, IN 46202-5 160, 2012, pp. 39-43.
5. Y. Del Valle, G. K. Venayagamoorthy, S. Mohagheghi, J. C. Hernandez, R. G. Harley, "Particle swarm optimization: Basic concepts, variants, and applications in power systems", IEEE Transactions on Evolutionary Computation 12 (2), 2008, pp.171-195.
6. SapnaKatiyar "Comparative Study of GA and the Particle Swarm Optimization", ABES Institute of Technology, NH-24, Vijay Nagar, Ghaziabad 2010UPin,akgec International Journal Of Technology, Vol. 2, Issue No. 2, pp. 21-24.
7. Sajedi, F. Khalifeh, Z. Khalifeh and T. Karimi "Application of Particle Swarm Optimization and GA methods for Vector Control of IMS", Department of Electrical Engineering, Kavar Branch, Islamic Azad University, Kavar, Iran. Australian Journal of Basic and Applied.

8. Abdel Merabet, Aman A., Karim Beddak. "Torque and State estimation for real-time implementation of multivariable control in sensorless induction motor drives", IET Electric Power Appl, Vol. 11, Issue No. 4, pp. 653-663.
9. Bhola Jha, M. K. Panda, Prafull Kumar Pandey, Lokesh Pant "PSO-Based Online Vector Controlled Induction Motor Drives" International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT) – 2016.

SOFT TREES

Dr. RAJESH K. THUMBAKARA
Department of Mathematics, M.A. College (Autonomous), Kothamangalam, Kerala, India

BOBIN GEORGE
Department of Mathematics, Pavanatma College, Murickassery, Kerala, India

Abstract

The concept of soft graph was introduced by Rajesh K. Thumbakara and Bobin George. Soft Graph is used to provide a parameterized study of graphs. In this chapter we discuss the concept of soft trees.
***Keywords**: Soft Graph; Soft Tree.*

1. Introduction

The basic idea of graphs were first introduced in the 18th century by the Swiss mathematician Leonhard Euler. Soft set theory is a mathematical tool for dealing the uncertainties. This novel concept was introduced by D. Molodtsov in 1999. Many problem in practical situations can be solved with the help of soft set theory rather than some well-known theories viz. probability theory fuzzy set theory, etc. since these theories have certain limitations. The problem with the fuzzy set is that it lacks parameterization tools. Many authors like P.K. Maji, R. Biswas and A.R. Roy [4], [5] have studied the theory of soft sets further and used to solve some decision making problems. Rajesh K. Thumbakara and Bobin George [10] introduced the concept of soft graph in 2014. They also introduced the concepts of soft tree, soft subgraph, soft complete graph etc. and discussed some operations of soft graph. In 2015, Muhammad Akram and Saira Nawas [1]

modified the definition of soft graph given by Rajesh K. Thumbakara and Bobin George. Muhammad Akram and Saira Nawas [2] also defined certain types of soft graphs like regular soft graph, soft tree etc. and also explained the concepts of soft bridge, soft cut vertex, soft cycle etc. J.D. Thenge, B.S. Reddy and R.S. Jain [7] contributed more ideas to connected soft graph. Also they [8] studied the concepts of radius, diameter and center of a soft graph and introduced the concept of degree in soft graph. J.D. Thenge, B.S. Reddy and R.S. Jain [9] discussed the concepts of adjacency matrix and incidence matrix of a soft graph in 2020. Domination over soft graphs is introduced by S. Venkatraman and R. Helen [11]. In this chapter we discuss the concept of soft trees with examples.

2. Preliminaries

2.1. Graphs

For basic concepts of graph theory we refer [3]. A graph G consists of two finite sets: V, the vertex set of G which is a nonempty set and E, the edge set which is possibly empty. G can be represented by (V, E) or $(V(G), E(G))$. The degree of a vertex v denoted by $d(v)$ is the number of edges of G incident with v. Let H be a graph with vertex set $V(H)$ and edge set $E(H)$ and G be a graph with vertex set $V(G)$ and edge set $E(G)$. Then we say that H is a sub graph of G if $V(H) \subseteq V(G)$ and $E(H) \subseteq E(G)$. A walk in a graph G is a finite sequence $W = v_0 e_1 v_1 e_2 v_2 \ldots v_{k-1} e_k v_k$ whose terms are alternately vertices and edges such that for $1 \le i \le k$, the edge e_i has ends v_{i-1} and v_i. We say this walk as a v_0-v_k walk. Here v_0 is called origin of the walk and v_k is called the terminus of the walk. A u-v walk is called closed or open depending on whether $u=v$ or $u \neq v$. Trivial walk is one containing no edges. The number of edges

in the walk is called the length of the walk. If the edges in the walk are distinct then the walk is called a trail. If the vertices of the walk are distinct then that walk W is called a path. A non-trivial closed trail in a graph G is called a cycle if its origin and internal vertices are distinct. A vertex u is said to be connected to a vertex v in a graph G if there is a path in G from u to v. A graph is said to be connected if every two of its vertices are connected. If $C(u)$ denote the set of all vertices in G that are connected to u then the subgraph of G induced by $C(u)$ is called the connected component containing u, or simply the component containing u. A graph is called a tree if it is a connected acyclic graph.

2.2. Soft Sets

In 1999 D. Molodtsov [6] initiated the concept of soft sets. Soft set is a mathematical tool for dealing with uncertainties.

Definition 2.2.1.

Let U be an initial universe set and let E be a set of parameters. A pair (F, E) is called a Soft Set (over U) if and only F is a mapping of E into the set of all subsets of the set U. That is, $F: E \rightarrow P(U)$.

3. Soft graph

Rajesh K. Thumbakara and Bobin George [11] introduced the concept of soft graph as follows.

Definition 3.1.

Let $G= (V, E)$ be a simple graph and A be any nonempty set. Let R be an arbitrary relation between elements of A and elements of V. That is $R \subseteq AXV$. A mapping $F: A \rightarrow P(V)$ can be defined as $F(x) = \{y \in V \mid xRy\}$. The pair (F, A) is a soft set over V. Then (F,A) is said to be a Soft Graph of G if the

subgraph induced by $F(x)$ in G is a connected subgraph of G for all $x \in A$.

Example 3.1.

Consider the graph $G= (V, E)$ given in figure 1.

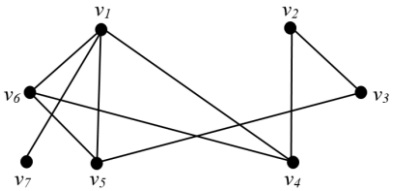


Figure 1. Graph G= (V, E)

Let $A = \{v_1, v_3\}$. Define the set valued function F by $F(x) = \{y \in V \mid d(x, y) < 2\}$. Then $F(v_1) = \{v_1, v_4, v_5, v_6, v_7\}$, $F(v_3) = \{v_2, v_3, v_5\}$. Here the subgraph induced by $F(x)$ in G which is denoted by $S[F(x)]$, is a connected subgraph of G, for all $x \in A$. These subgraphs are shown in figure 2.

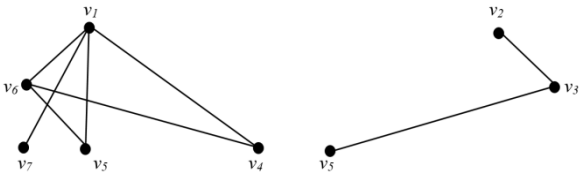


Figure 2. Subgraphs S [F(v_1)] and S [F(v_3)]

Here subgraphs induced by $F(v_1)$ and $F(v_3)$ are connected subgraphs of G. Therefore (F, A) is a soft set.

Definition 3.2.

Muhammad Akram and Saira Nawas [1] modified the definition of soft graph as follows.

Let $G^*= (V, E)$ be a simple graph and A be any nonempty set. Let R be an arbitrary relation between elements of A and

elements of V. That is $R \subseteq AXV$. A mapping $F: A \to P(V)$ can be defined as $F(x) = \{y \in V \mid xRy\}$. Also define a mapping $K: A \to P(E)$ by $K(x) = \{uv \in E \mid \{u,v\} \subseteq F(x)\}$. The pair (F, A) is a soft set over V and the pair (K, A) is a soft set over E.

Then the 4-tuple $G = (G^*, F, K, A)$ is called a soft graph if it satisfies the following conditions:

1) $G^*=(V,E)$ is a simple graph,
2) A is a nonempty set of parameters,
3) (F,A) is a soft set over V,
4) (K,A) is a soft set over E,
5) $(F(a),K(a))$ is a subgraph of G^* for all $a \in A$

If we represent $(F(x), K(x))$ by $H(x)$ then soft graph G is also given by $\{H(x): x \in A\}$

Example 3.2.

Consider a graph $G^*= (V, E)$ as shown in the following figure 3.

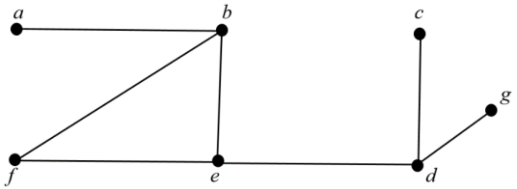


Figure 3. Graph G*= (V, E)

Let $A = \{f, d\} \subseteq V$ be a parameter set and (F, A) be a soft set with its approximate function $F: A \to P(V)$ defined by $F(x) = \{y \in V \mid xRy \Leftrightarrow d(x,y) \leq 1\}$ for all $x \in A$.

That is, $F(f) = \{b, f, e\}$ and $F(d) = \{g, c, d, e\}$.

Let (K, A) be a soft set over E with its approximate function $K: A \to P(E)$ defined by $K(x) = \{uv \in E \mid \{u,v\} \subseteq F(x)\}$ for all $x \in A$.

That is, $K(f) = \{be, bf, ef\}$ and $K(d) = \{cd, de, dg\}$.

Thus $H(f) = (F(f), K(f))$ and $H(d) = (F(d), K(d))$ are sub graphs of G^* as shown in figure 4.
Hence $G = \{H(f), H(d)\}$ is a soft graph of G^*.

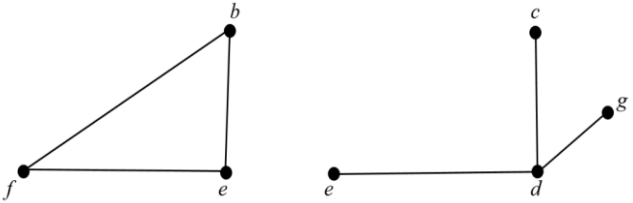


Figure 4. Soft Graph G= {H (f), H (d)}

The tabular representation of the soft graph $G = \{H(f), H(d)\}$ is given in Table 1.

Table 1. Tabular representation of the Soft Graph G= {H (f), H (c)}

A/V	*a*	*b*	*c*	*d*	*e*	*f*	*g*
f	0	1	0	0	1	1	0
d	0	0	1	1	1	0	1

A/E	*ab*	*be*	*bf*	*cd*	*de*	*dg*	*ef*
f	0	1	1	0	0	0	1
d	0	0	0	1	1	1	0

Definition 3.3.

Let $G^* = (V, E)$ be a graph and $G = (G^*, F, K, A)$ be a soft graph of G^* which is also represented by $\{H(x): x \in A\}$. Then $H(x)$ corresponding to a parameter x in A is called a part of the soft graph G.

4. Soft tree

Definition 4.1.

Let $G^*= (V, E)$ be a graph and $G = (G^*, F, K, A)$ be a soft graph of G^* represented by $\{H(x): x \in A\}$ where $H(x) = (F(x), K(x))$. Then G is called a soft tree if the part $H(x)$ of G is a tree for every $x \in A$.

Example 4.1.

Consider a graph $G^*= (V, E)$ as shown in the following figure 5.

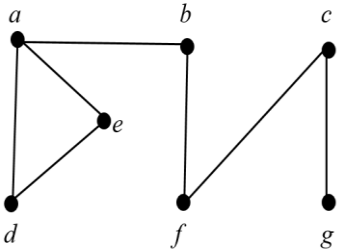


Figure 5. Graph G*= (V, E)

Let $A = \{d, f\} \subseteq V$ be a parameter set and (F, A) be a soft set with its approximate function $F: A \to P(V)$ defined by $F(x) = \{y \in V \mid xRy \Leftrightarrow d(x, y) \leq 1\}$ for all $x \in A$.

That is, $F(d) = \{a, b, e\}$ and $F(f) = \{b, c, f\}$.

Let (K, A) be a soft set over E with its approximate function $K: A \to P(E)$ defined by $K(x) = \{uv \in E \mid \{u, v\} \subseteq F(x)\}$ for all $x \in A$.

That is, $K(d) = \{ad, ae, de\}$ and $K(f) = \{bf, cf\}$. Thus $H(d) = (F(d), K(d))$ and $H(f) = (F(f), K(f))$ are sub graphs of G^* as shown in figure 6. Hence $G = \{H(d), H(f)\}$ is a soft graph of G^*.

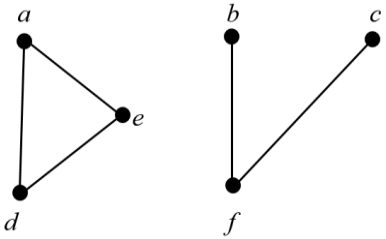


Figure 6. Soft Graph G = {H (d), H (f)}

Here *G* has two parts *H* (*d*) and *H* (*f*) in which *H* (*d*) is not a tree and *H* (*f*) is a tree. i.e. All parts of *G* are not trees. So *G* is not a soft tree.

Example 4.2.

Consider a graph G^*= (*V, E*) as shown in the following figure 7.

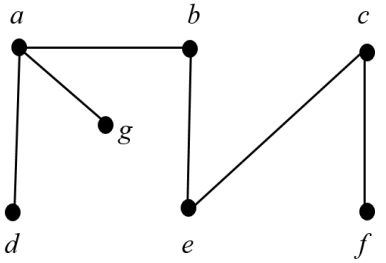


Figure 7. Graph G^*= (V, E)

Let $A = \{a, e\} \subseteq V$ be a parameter set and (*F, A*) be a soft set with its approximate function $F: A \to P(V)$ defined by $F(x) = \{y \in V \mid xRy \Leftrightarrow d(x, y) \leq 1\}$ for all $x \in A$.

That is, *F (a)* = {*a, b, d, g*} and *F* (*e*) = {*b, c, e*}.

Let (*K, A*) be a soft set over *E* with its approximate function *K:* $A \to P(E)$ defined by *K(x)* = $\{uv \in E \mid \{u, v\} \subseteq F(x)\}$ for all $x \in A$.

That is, $K(a) = \{ab, ad, ag\}$ and $K(e) = \{be, ce\}$. Thus $H(a) = (F(a), K(a))$ and $H(e) = (F(e), K(e))$ are sub graphs of G^* as shown in figure 8. Hence $G = \{H(a), H(e)\}$ is a soft graph of G^*.

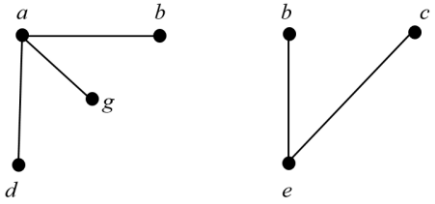


Figure 8. Soft Graph G = {H (a), H (e)}

Here G has two parts $H(a)$ and $H(e)$ and both of them are trees. So the soft graph G is a soft tree.

Conclusion

Soft graph was introduced by applying the concept of soft set in graph. By means of parameterization, soft graph produces a series of descriptions of a complicated relation described using a graph. Theory of soft graphs is a fast developing area in graph theory due to its capability to deal with the parameterization tool.

References

1. M. Akram, S. Nawaz, Operations on Soft Graphs, Fuzzy Inf. Eng. (2015) 7,423-449
2. M. Akram, S. Nawaz, Certain Types of Soft Graphs, U.P.B. Sci. Bull., Series A, Vol. 78, iss. 4 (2016), 67- 82
3. J. Clark, D. A Holton, A first look at graph theory, Allied Publishers Ltd., 1995
4. P.K. Maji, A.R. Roy, R. Biswas, Fuzzy Soft Sets, The Journal of Fuzzy Math, 9(2001), 589-602

5. P.K. Maji, A.R. Roy, R. Biswas, An Application of Soft Sets in a Decision Making Problem, Computers and Mathematics with Application, 44 (2002), 1077-1083
6. D. Molodtsov, Soft Set Theory-First Results, Computers & Mathematics with Applications, 37 (1999) 19- 31
7. J. D. Thenge, B. S. Reddy, R.S. Jain, Connected Soft Graph, New Mathematics and Natural Computation, Vol.16, No.2 (2020) 305-318
8. J.D. Thenge, B.S. Reddy, R.S. Jain, Contribution to Soft Graph and Soft Tree, New Mathematics and Natural Computation (2020)
9. J.D. Thenge, B.S. Reddy, R.S. Jain, Adjacency and Incidence Matrix of a Soft Graph, Communications in Mathematics and Applications, Vol. 11, No.1 (2020), 23-30
10. R. K. Thumbakara, B. George, Soft Graphs, Gen. Math. Notes, Vol. 21, No. 2 (2014) ,75-86
11. S. Venkatraman, R. Helen, On domination in soft graph of some special graphs, Malaya Journal of Matematik, Vol. S, No. 1 (2019), 527-531

MICROBIOLOGICAL QUALITY AND MULTIDRUG RESISTANCE PATTERN OF ISOLATED PATHOGENIC BACTERIA OF READY-TO-EAT AND STREET FOODS IN DHAKA CITY, BANGLADESH

AVIJIT BANIK & MARUF ABONY
Department of Microbiology, Primeasia University, Dhaka, Bangladesh

SYEDATASNEEM TOWHID
Department of Microbiology, Jagannath University, Dhaka, Bangladesh

ZAKARIA AHMED
Microbiology Department, Technology Wing, Bangladesh Jute Research Institute, Dhaka, Bangladesh

Abstract

The objective of this research was to evaluate the microbiological safety of street and ready-to-eat food available in Dhaka city, Bangladesh and check the risk factors associated with ingestion of food from popular public places. Forty-five ready-to-eat food samples belonging to 18 categories were collected aseptically from local Street vendors & Super shops respectively. Ninety street food samples belonging to 7 different categories were collected aseptically from ten different places in Dhaka. Total Viable Count (TVC) and Total Coliform Count (TCC), Total Salmonella-Shigella Count (TSSC) and Total S. aureus Count (TSAC) were estimated. Antibiogram of the isolated strains were conducted with commercial antibiotics according to Kirby-Bauer disc diffusion method. Identification of the coliforms together with antibiotic-resistance profile showed Escherichia coli, Enterobacter sakazaki, Citrobacter freundii and Salmonella typhimurium were present in various foods. Fried Aubergine, sugarcane juice, potato balls, roasted peanut, rice cake, sweetened coconut, local salty snacks nimki and chanachur, sesame cookies revealed high total viable count (10^{11} CFU/gm or /mL) and high total coliform count (10^{9} CFU/g or /mL). Some

street foods were found to contain potential pathogens such as E. coli, Staphylococcus aureus, Salmonellaspp., Vibrio spp. and Campylobacterspp. E. coli and S. typhimurium showed increased sensitivity against Ampicillin 10mg and Sulfamethoxazole 25mg. Occurrence of antibiotic-resistance potential pathogens in ready-to-eat food poses a considerable health risk to consumers. Public awareness and timely assessment of food safety are needed to avoid the risks of food-borne infection and intoxication from ready-to-eat food. Some of the isolates of E. coli, S. aureus and Salmonella isolates were found to be resistant against Azithromycin (15µg), Sulphomethoxazole (25µg), Penicillin (10µg), NalidixicAcid (30µg), Vancomycin (30µg) and Tetracycline (30µg). This study reveals the presence of pathogenic bacteria in street foods& ready to eat foods of Dhaka, Bangladesh. Hence, there is a necessity for strict surveillance on microbial safety of street foods. There should be public engagement projects for public awareness against consumption of low-quality and unhygienic street& ready to eat foods of Dhaka, Bangladesh.

Keywords: *Coliform Bacteria, Food Safety, Food Awareness, Multi-drug resistance, Street foods and Ready-Eat-Food.*

Introduction

The food-borne outbreak is a pressing issue for public health and economy [1].Current modification in food production, processing practices and rapidly-changing food habits of the consumer are important factors for the increasing consumption of street foods. Food-borne diseases (FBD) represent an important worldwide health problem and now it's involving a wide range of illness caused by viral, bacterial, parasitic and chemical contamination of food [1].Many of the food-borne illnesses occur due to viruses and bacterial agents [2]. Among food-borne diseases, diarrhoea is one of the most serious global concerns [3]. Approximately 1.7 billion cases of child deaths caused by diarrhoeal diseases are recorded annually worldwide and most of these cases are attributed to contaminated food and water [4]. The annual reports from the World Health Organization (WHO) stated in

Bangladesh, diarrhoea is responsible for one-third of infant deaths and this is likely to be a gross underestimation of the true burden. Limited data from the International Center for Diarrhoeal Disease Research, Bangladesh (ICDDR, B) indicates 501 hospital visits per day for treatment of diarrhoea that were attributable to food and water-borne pathogens [5]. Gradually-developing and rapidly-urbanizing countries like Bangladesh are experiencing change in traditional food habits. Changing life-style, involvement of woman in official jobs and change in the family structure forces people to consumestreet foods in contrast to the home-cooked food which was the common practice [6].During festivals, weekend and holiday's people roam and consume street food. Unique flavours, easy availability, cheapest price as well as convenient, street foods are attractive option than home-cooked food, especially among the young and low-income community [6, 7]. Unhygienic conditions, open yards displays and easy contamination from dust, insects, smoke, hands of vendor, lack of access to basic sanitary facilities such as potable water, sanitation of personnel and equipment, lack of disposal of garbage lead to cross-contamination of street foods [8]. People consuming street food on a regular basis are more vulnerable to food-borne diseases like as diarrhoea, cholera, typhoid fever and food poisoning [9, 10]. While these street foods often substitute homemade food for the urban population, the unhygienic conditions in which these foods are prepared, stored and served raise a question regarding their microbiological quality. Food-borne outbreaks cause wide range of illnesses from bacterial, viral, protozoa and chemical contamination of food [11]. Most deaths in hospital are due to bacterial agents; however viruses cause half of the food borne diseases [12]. Pathogens cause a large spectrum of these infections or intoxications, such as enteric complications,

abdominal pain, fever, hemorrhagic colitis, bloodstream infection, meningitis, joint infection, kidney failure, paralysis, miscarriage, etc that was reported previously [13].The common manifestation of food poisoning occurs by diarrheal diseases, which is often caused by a toxin released from microbes [14, 2]. WHO estimates that globally food-borne and waterborne diseases together kill about 2.2 million people annually, 1.9 million of whom are children.[14, 5] In Bangladesh, diarrhea is responsible for one-third of childhood deaths, the actual number of casualty might be underestimated in absence of a national health database. The insufficient data on food-borne infection shows 501 diarrhoeal cases are reported daily during monsoon seasons [5, 15]. Due to the absence of regular monitoring, assessment of the public health impact of food-borne illnesses is a tedious task. Ready-to-eat foods are often consumed at the sale points in the ready food conditions and it could be cooked or raw, hot or chilled consumed without any types of further cook treatment [16, 17].Traditional food habits of general Bangladeshi people are changing with passing time due to rapidly evolving urbanization. Changing lifestyle, the involvement of the woman in official jobs and change in the family structure are encouraging more people to consume ready-to-eat food in contrast to the home-cooked food which was the common practice in the last century. In the current economical age, many local food factories process traditional food items and market them in small packs, commonly known as 'home-made' items. Unfortunately, such food items are sold by groceries, departmental store, vendors and super shops without supervision of authorities. These ready-to-eat foods often substitute homemade foods and are important for the nutritional status of the urban population. The unhygienic condition during production, preparation and

selling of food often deteriorates the microbiological quality of food items [18].At present, the tendency of consuming ready-to-eat food products has increased tremendously. Attractive packages, marketing on a reputed shop and good advertisement strategies encourage people to consume certain products without checking for food safety and nutritional information. Generally, the food manufacturers in Bangladesh need to obtain license from Bangladesh Standard Testing Institute (BSTI) to market their products. BSTI follows the guidelines of the International Organization for Standardization (ISO) to ensure food safety [19, 20]. High-risk pathogens like *Campylobacter* spp., vero-toxigenic *Escherichia coli* (VTEC), *Salmonella* spp., *Shigella* spp. and *V. cholerae* should be absent in ready-made foods according to food quality standards [21].This microbiological study showed the prevalence of considerable numbers of aerobic and coliform bacteria in ready-to-eat food. This study also pointed out those multidrug-resistant bacteria might be dispersing over the population through contaminated ready-to-eat foods, an observation shared by similar reports from independent groups [11]. To assess the potential risk to public health this study also suggested conducting a detailed microbial analysis and profiling their drug-resistance patterns. Consequently, the purpose of this study was to appraise the microbial status of food-borne pathogens, spoilage bacterial content, and food processing hygiene different ready-to-eat foods from Dhaka city, Bangladesh. This study was carried out to evaluate the microbial status and multidrug resistance pattern of pathogenic bacteria isolated from street foods in Dhaka City, Bangladesh.

Materials And Methods

Sample Collection, Preparation and Enrichment Procedure:

A total of 90 street food samples were collected in triplicates (fried salty, spicy boiled, sweet sugary solids, fruits, juice and rice cookies) from different vendors from 10 different areas (Banani, Mohakhali, Agargaon, Baridhara, Nilkhet, Uttara, Rampura, Farmgate, Dhanmondi and Newmarket) around Dhaka city, Bangladesh; whereas ready-to-eat food samples were collected at random from the local shops and vendors in Dhaka city comprising of the most crowed places. Eighteen (18) categories of food items were purchased in triplicates from local street vendors and local superstore of Dhaka city. Collected samples were taken to the laboratory within the earliest time from purchase for further processing and analysis [19].

Solid food samples were collected in pre-sterilized stomacher bags (165mmx150mmx 0.55mm) and freshly-extracted juice samples (100ml each) were collected in sterile bottles, transported to the laboratory in ice-boxes (4°C) within 2 hours for processing and further assessment. All samples were analyzed according to the standard microbiological methods for food analysis [22]. Ten grams of solid food sample was added to 90ml of normal saline, homogenized and prepared for spread plate technique. For juice samples, 10ml of samples were properly diluted in 90ml sterile normal saline (0.85% NaCl). One ml of each homogenate from samples was added in decimal dilutions up to 10^{-6}in 0.85% NaCl solution. Plate Count Agar was used to determine Total Viable Bacterial Count (TVBC). *Salmonella-Shigella* agar (SSA), Mannitol Salt Agar (MSA) and Eosine Methylene Blue agar (EMB) were used to identify enteric pathogens *Salmonella-Shigella, S. aureus* and *E. coli,* respectively.

Microbiological Analysis:

Twenty-five gram (25g) of each sample was homogenized in 225 milliliters of buffered peptone water and incubated overnight at 37°C. One milliliter pre-enrichment culture was mixed with 10 milliliters of Henja-Tetrathionate Broth and was incubated at 37°C for 24 hours (Khare et al 2018). The culture broths were subsequently streaked onto Salmonella-Shigella Agar (SS) media and Bismuth-Sulphite Agar (BSA) media. Presumptive identification of each colony came from biochemical tests and biochemically confirmed isolates were reconfirmed with API 20E kits [19, 23].The identification of the isolates upto genera was confirmed with API20 (**Table1**). The *E. coli* isolates were tested for detection of β- glucouronidase on *E. coli*-methyl umbiliferylglucuronate medium under standard bacteriological conditions.

For determining the microbial load in samples, the total viable count (TVC) and total coliform count (TCC) were determined with spread-plate method. The plate count agar and MacConkey agar respectively used to indicate the TCC and TVC for the collecting samples. 1g of each sample was diluted in 10-folds in sterile normal saline water (0.85 % NaCl) and properly diluted up 10^{-1} to 10^{-6} decimal in normal saline water [19]; 100µL from each dilution of each sample were spread on selected media by spread plate method with sterile glass spreader. Plates were incubated overnight at 37 °C and visible colonies were counted and represented as CFU/g or CFU/ml in log scale. Cell counts (CFU/g and CFU/ml) were derived from average of 3 independent experiments(Misra et al 2012, Malek et al 2016) (**Fig. 1**).

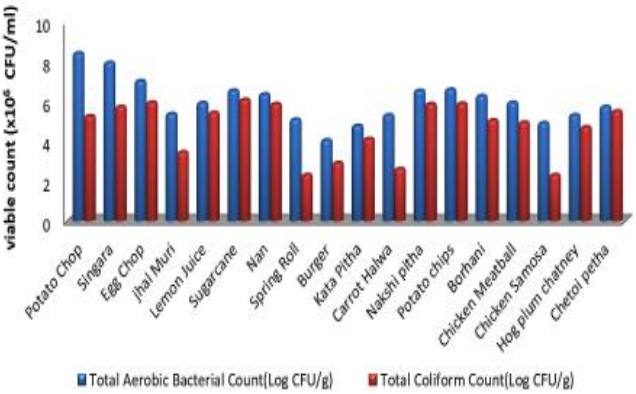


Fig. 1: Total Aerobic Count and Total Coliform Count of ready-to-eat items from Dhaka city.

Isolation and Presumptive identification of Specific Pathogens:

The pre-enrichment technique was used to detect delicate food pathogens *E. coli*, *Salmonella* spp., *S. aureus, Vibrio* spp. and *Campylobacter* spp. Twenty-five g of each sample was homogenized in 225ml of buffered peptone water and incubated at 37°C for 20 to 24h, followed by culture in specific medium as detailed in the next sub-sections.

Salmonella spp:

One ml of pre-enrichment culture was mixed with 10 ml of HenjaTetrathionate Broth and was incubated at 37°C for 20 to 24 h. The culture broths were subsequently streaked onto Salmonella-Shigella agar (SSA) and Bismuth Sulphite agar (BSA) to identify *Salmonella* spp.

Vibrio spp:

One ml of the homogenized food sample was mixed with 9ml of alkaline peptone Broth, incubated at 37°C for 20 to 24 h at alkaline level pH (8-9) spread onto Thiosulfate Citrate bile

salts sucrose (TCBS) agar media and incubated for 24h at 37°C to identify *Vibrio* spp.

Campylobacter spp.:

One ml of the homogenized food sample was mixed with 10 ml of Preston Campylobacter Enrichment Broth (PCE) and was incubated at 37°C for 8 h. Then the culture broth was spread on Charcoal Cefoperazone Deoxycholate agar (CCDA) media incubated for 24 h at 37°C in aerobic condition for the presumptive identification of *Campylobacter* spp.

E. coli :

The pre-enriched 1ml cultures were mixed with 9 ml lactose broth medium with Durham fermentation tubes and incubated at 37°C for 20 to 24 h. Gas production in the tubes was used to indicate the presence of fecal coliforms. The enrichment culture streaked onto Eosine Methylene Blue agar (EMB) and MacConkey Agar Media and incubated for 24 h at 37°C to identify *E. coli*.

S. aureus:

The homogenized food sample was streaked onto Mannitol Salt agar medium and incubated at 37°C for 20 to 24 hours to identify *S. aureus*.

Biochemical Tests for Identification of Isolates

Pure colonies from nutrient agar (NA) plates were taken for biochemical tests such as Kligler Iron Agar (KIA), Simmons citrate agar media, MR-VP media for Methyl red and Voges-Proskauer test, SIM media for Indole and motility test, Oxidase and catalase test for super-oxide dismutase and hydrogen peroxide and API 20E kits for biochemical profiling [24]. All pure discrete colonies from selective media were sub-

cultured on nutrient agar and subjected to biochemical tests for confirmation of initial isolation procedure and all isolates were identified presumptively up to the Genus level according to Bergey's Manual of Determinative Bacteriology [24, 25].

Antibiotics Susceptibility Test

The isolates of different genera were subjected to antibiotic resistance profiling in vitro through Kirby-Bauer method [26] against Commercial antibiotic discs ofAzithromycin (AZM) 15µg, Ciprofloxacin (CIP) 5µg, Sulfamethoxazole (SXT) 25µg, Tetracycline (TE) 30µg, Imipenem (IPM) 10 µg, Streptomycin (S) 10µg, Meropenem (MEM) 10µg, Penicillin (P) 10µg, Vancomycin (VA) 30µg, Rifampicin (RIF) 5µg,Gentamicin (CN)10µg, Kanamycin (k) 30µg, and NalidixicAcid (NA) 30 µg. Briefly, 5ml of Mueller–Hinton broth was inoculated with a pure culture of a specific isolate and incubated at 37°C for 24 h. The turbidity of actively growing broth culture was adjusted to a 0.5 McFarland standard. The zone diameter for individual antimicrobial agents was interpreted into categories of susceptible, intermediate and resistant according to the guidelines from National Committee for Clinical and Laboratory Standards [27]. The results from this assay were compared to the findings of other similar studies by Uddin et al. 2017, Mahfuza et al. 2016 and Tabashsum et al. 2013 [28-30].It allowed determination of the action of the antibiotic which shows the inhibition of the pathogen to the degree proportional to the diameter of the zone of inhibition that resulted from diffusion of the antimicrobial that surrounding the disc onto the agar medium.

Statistical Analysis:

After conducting biochemical analysis of isolates, results were analyzed in STATA 14.1 statistical program for cluster analysis by multivariate analysis inward linkages.

Result

The present study was conducted to isolate and identify bacteria in street foods with the status of vendors, vending site and food handling practices along the streets in Dhaka city. The isolates obtained from different samples from significant locations were observed in street and ready-to-eat foods (Table 1 & 2).

Table 1: Food items collected from different parts of Dhaka, Bangladesh

Location in Dhaka City	Food item	Food category	Food content
a.New Market Area, b. Nilkhet, c. Dhanmondi, d. Farmgate, e. Agargaon, f. Rampura, g. Mohakhali, h. Banani, i. Baridhara and j. Uttara	Hogplum, cucumber, pineapple, local plum Carrot, Guava	Raw fruit	Sour solid fruit
	Sweet pea	Boiled food	Boiled sweet pea, onion, spices
	Monakki, Morali, Coconut chips	Sugar-coatedcrisp	Crispy sticks made of wheat flour coated with sugar
	Kadma, Sesame sticks, Coconut crisp	Sugary solid	Traditional sweet-balls made of sugar
	Onion crisp	Salty fried food	Onion and mashed lentil fried with spices
	Fried peanut		Roasted peanut fried in oil with salt, sweet and spices
	Potato balls		Mashed potato moulded into balls with corn flour, onions and spices
	Fried Aubergine		Sliced aubergine coated with flour and spice

	Chanachur		Assortment of wheat flour,lentil flour and nuts
	Stuffed dumplings		Cooked vegetables andmeat wrapped with thick layer of wheat flour
	Fried dumplings		Meatballs cooked with spice
	Potato chips		Fried slices of potato
	Nimki		Fried chunks of wheat flour
	Soup	Thick salty liquid	Corn flour, salt, sugar, spice, protein, lipid
	Puffed rice	Salty roasted	Puffed rice roasted in oil and spice
	Popcorn		
	Sweatpea		
	Sugarcane Juice	Sugary liquid	Fresh pressed juice of sugarcane
	Rice cake	Salty steamed	Soft lumps of rice floursteamed
	Lemon juice	Acidic liquid	Lemon, salt and sweet mixtures.

Figure 1: Sampling area in Dhaka City

a.New Market Area,b. Nilkhet, c. Dhanmondi, d. Farmgate, e. Agargaon, f. Rampura, g. Mohakhali,h. Banani, i. Baridhara and j. Uttara

Table 2: API-20 identification tests for bacterial isolates from the ready-to-eat food samples from Dhaka, Bangladesh

Name of food sample	Percentage of API in anisolated microorganism
Singara	*E. coli* - 97.7%;*Salmonella typhimurium*-97.5%
Egg Chop	*E. coli* - 99.7%;*Salmonella typhimurium*-95.5%
Lemon Juice	*E. coli* - 99.7%*Citrobacterfreundii* - 96.9%
Sugarcane	*E. coli* - 98%*Citrobacterfreundii* - 99.9%
Nan	*Entrobactersakazaki* - 98%

Kata Pitha	*E. coli* - 99.9%
Potato chips	*E. coli* - 95.8%
Nakshipitha	*E. coli* - 99.7%
Chicken Samosa	*Citrobacterfreundii* - 99.7%
Hog plum chatney	*E. coli* - 99.5%

The API-20 test was done on selected isolates of *E. coli*, *Enterobactersakazaki*, *Citrobacterfreundii* and *Salmonella typhimurium* to conform the result of the biochemical test (**Table 3**).

Table 3: Biochemical profile of bacterial isolates from ready-to-eat foods.

Isolated Strains	KIA			H_2S	Indole test	MR test	VP test	Citrate test	Oxidase test	Catalase test	Motility	Gram Stain
E. coli	Y	Y	+	-	+	+	-	-	-	+	+	Rod, (-)
Salmonella sp.	R	R	-	+	-	+	-	-	-	+	+	Rod, (-)

KIA= Kligler's Iron Agar, Y= Yellow (acid), R=Red (Alkaline), MR= Methyl Red, VP=Voges-Proskauer test, positive= (+), Negative= (-).

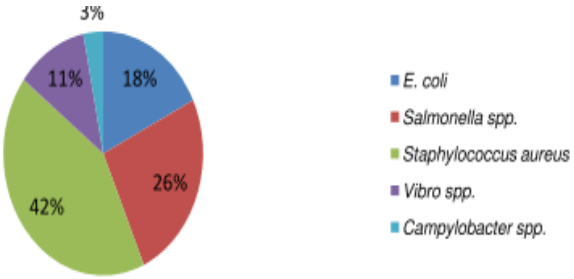


Fig. 1: Number of isolated bacteria from street foods

The *E. coli* isolates were further cultured on EC-MUG medium (Oxoid, Hampshire, England) to observe the presence of β-glucuronidase with the probability of finding *E. coli* O157:H7, because the dangerous *E. coli* O157:H7 strains are negative for β-glucuronidase (**Table 4**) [31.

Table 4: Production of β-glucuronidase from the *E. coli* isolates from ready-to-eat food items from Dhaka

Sample name	B-glucuronidase
Singara	+
Egg Chop	+
Lemon Juice	+
Sugarcane	+
Kata Pitha	+
Nakshipitha	+
Potato chips	+
Hog plum chutney	+

Positive = (+), Negative=(-)

Finally, the antibiotic resistance pattern of the isolates indicated Ampicillin and Sulfamethoxazole resistance (**Figure 5 and 6**).

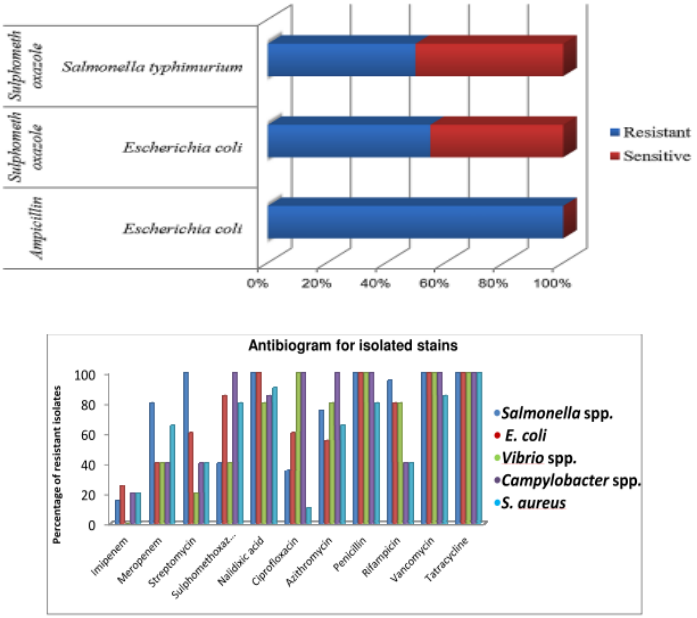


Fig. 5: Antibiotic resistance profile of the most abundant bacteria isolated.

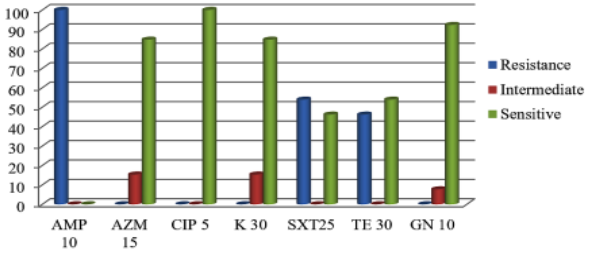
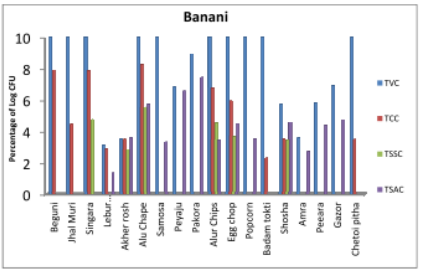


Fig. 6: Antibiotic sensitivity pattern of bacterial isolates from ready-to-eat food samples from Dhaka

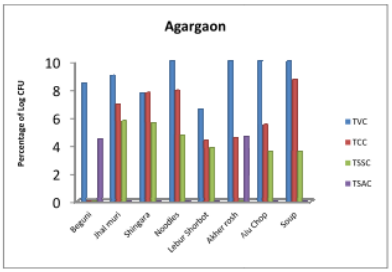
The microbial assay and colony counts were compared to the Bangladesh Standard Testing Institute (BSTI) catalogue 2018(BSTI 2018) [20].

The highest count for TVC was noted from potato balls collected from Banani was (10^{11} CFU/g) and Rampura (10^{10}

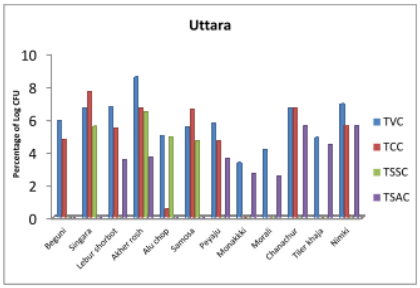
CFU/g), soup from Agargaon (10^{10} CFU/g) and puffed rice (10^{8} CFU/g) from Farmgate. Highest TCC and TSAC counts were seen from potato balls from Banani.Fried aubergine from Agargoan showed TCC count (10^{8} CFU/g) followed by the similar result from the same item collected from Nilkhet. TSSC was found in the range between (10^{2}CFU/ml orgm to 10^{7}CFU/ml or g) from collected food samples. Puffed rice from Baridhara showed the highest TSSC and fried chickpeas from Nilkhet presented the lowest TSSC recorded. Sugarcane juices yielded the highest number of TVC (10^{8}CFU/ml to 10^{10}CFU/ml). On the other hand lowest microbial count was seen in Hogplum from Banani; TCC (10^{4}CFU/gm) and TSSC (10^{3}CFU/gm). Monaki samples from Uttara, fried peanut from Mohakhali and Kadma from New Market Area showed similar result. Notably, these are all ready-to-eat or already cooked products consumed directly after purchase. Any residing pathogen will gain direct access to the intestine, resulting in probable disease. The occurrence of overwhelming numbers of *Salmonella* sp. or *E. coli* or both in many food items makes them absolutely unfit for consumption. Potato balls, stuffed dumplings (Shingara), egg balls, cucumber and sugarcane juice from Banani showed highTSSC count (10^{7}CFU/g), which is potentially harmful for consumption. Fried products such as fried dumplings (samosa), potato balls and fried aubergine from Banani showed the highest range of TSAC (10^{5} to 10^{7}CFU/gm). The summary of the microbial isolates from the food samples are given in (**Fig. 7A-J**).



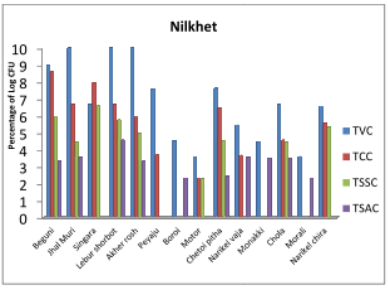
1A.Microbial counts of food from Banani



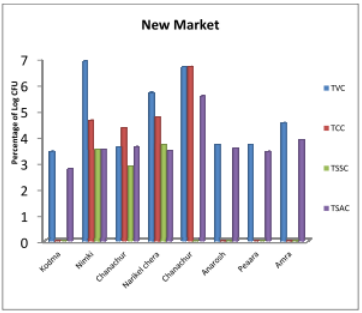
1B. Microbial counts of food from Agargaon



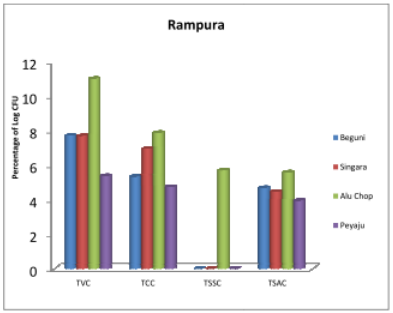
1C. Microbial counts of foods from Uttara



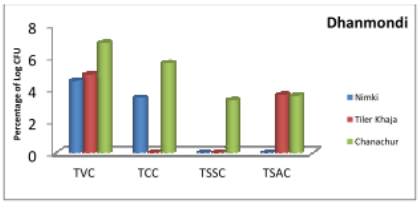
1D. Microbial counts of foods from Nilkhet



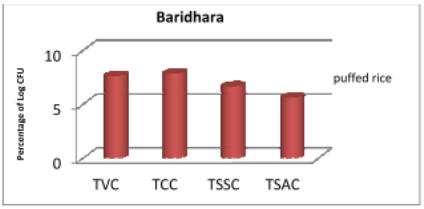
1E. Microbial counts of foods from New Market Areas



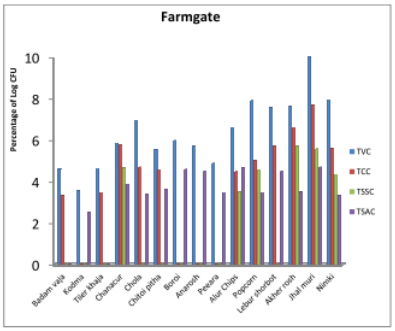
1F. Microbial counts of foods from Rampura



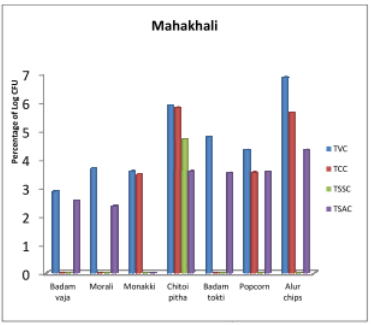
1G. Microbial count of foods from Dhamnmondi



1H. Microbial counts of foods from Baridhara



1I. Microbial counts of foods from Farmgate



1J. Microbial counts of foods from Mahakhali

Fig. 7 (1A-1J): Bacterial count for food samples from ten different areas in Dhaka city, Bangladesh.

Note:

TVC (Total viable count), TCC (Total coliform count), TSSC (Total *Salmonella-Shigella* count), TSAC (Total *Staphylococcus aureus* count)

Food items:

Fried aubergine = beguni, stuffed dumpling = singara, lemon juice = leburshorbat, sugarcane juice = akhershorbot, alu chop = potato ball, fried dumpling = samosa, onion crisps = peyaju, sesame sticks = tilerkhaja, jhalmuri = puffed rice, local plum = boroi, sweatpea = moto, rice cake = chetoipitha, coconut crisp = narikelchira, coconut chips = narikelvaja,

pineapple = anarosh, Guava = peyara, hogplum = amra, potato chips = alu chips.

All the samples of street food showed presence of various bacterial pathogens. *E. coli* was found in 28 samples, *Salmonella* spp. in 40 samples, *Campylobacter* spp. in 5 samples, *Vibrio* spp. in 18 samples and *S. aureus* in 66 samples. Biochemical tests revealed biochemical profile representative of respective genera presented in Bergey's Manual of Determinative Bacteriology [24].In this study, different kinds of "Ready-to-eat" food including sugarcane juice, lemon juice, kata pitha, chetoipitha (traditional rice cookies), carrot halwa, Nakshipitha (sweetened dissert), nan (bread), potato chips, singara, egg chop, potato chop, spring roll, chicken meatball, chicken samusa (fried snacks), burger, jhalmuri (Spicy puffed rice), borhani (spiced yogurt drink), hog plum chatney (pickle) were analyzed. Some specific food like spring roll, sugarcane had both spoilage flora and bacterial pathogens as stated by others before [32-34]. In Bangladesh, food contamination exposes consumers to food-borne hazards. Lack of awareness and lack of adherence to the food laws and regulation together with infrequent implementation of existing regulations are contributing significantly to dissatisfactory food safety circumstances of Bangladesh [12, 4].

Street-vended, ready- to-eat food items are becoming a globally growing trend for ease, quickness and convenience [35, 31]. As per a report, a range of food-borne infections are the cause of most microbial diseases. In the developing countries a high level of mortality rate is found due to bacterial diarrhea [36]. The frequency of typhoid among the city slum-dwellers is estimated as 3.9 episodes per year when

screening in one thousand people whereas in case of pre-school children who are aged between 2 to 5 years were estimated to be 8.9 times more at a risk of getting infected by typhoid [31]. Among the diarrhea affected people in Dhaka city, *Salmonella* covered 6.4% of the bacterial isolates [36]. Contaminated water, food and person-to-person contact are the important sources of *Salmonella* spp. and *E. coli*. This study emphasizes the role of sub-standard food items retailed in the super-shops as a source of *Salmonella* spp. and *E. coli* infection. Globalization has made foreign items like chicken nuggets and sausages popular to the urban youth. Moreover, the popular traditional items like rice cookies (pitha), mashed sweets (Halwa) and hard caramels (Badampapri, Helen papri) are only marketed by small-scale industries popularly advertised as 'Homemade' products. The name, number and location of these traditional small-scale producers (Home-made brand) are not recorded with the Bangladesh Standard Testing Institute (BSTI). The BSTI approval does not appear on the packages of the homemade brands. The occurrence of high Total Heterotrophic Count (HTC) and relatively high Total Coliform Count (TCC) reflect poor quality of the finished product. Fried foods like potato chips, egg chop, singara, chicken meat ball, baked items like Nan, sugary foods like sugarcane juice, nakshipitha have high burden of TAC ($6x10^6$CFU /mL) and TCC (> $4x10^6$ CFU/mL). *E. coli* was found as the dominant species from singara, egg chop, lemon juice, sugarcane juice, kata pitha, potato chips, nakshipitha and hogplumchutney.

The multi-drug resistance profile of potential food-borne pathogens identified in this study is of concern. In case of street foods most of the isolates of the *Salmonella* spp. are resistant against Streptomycin, NalidixicAcid, Azithromycin,

Rifampicin and Penicillin. *S. aureus* found to be resistant against Penicilin, Meropenem, Sulphomethoxazole, NalidixicAcid and to a lesser extent, Vancomycin. The *Campylobacter*Spp. isolates were found to be resistant against Sulphomethoxazole, NalidixicAcid, Ciprofloxacin, Azithromycin and Penicillin. The *Vibrio*Spp. isolates showed resistance to NalidixicAcid, Ciprofloxacin, Azithromycin, Rifampicin, Vancomycin, Tetracycline and Meropenem. The *E. coli* isolates were found to be resistant against Streptomycin, Sulphomethoxazole, NalidixicAcid, Ciprofloxacin and Rifampicin. The isolates were found to be resistant against sulphomethoxazole, nalidixic acid, ciprofloxacin, azithromycin andpenicillin.The spread of multi-drug resistant isolates poses hazard of an endemic. This could be particularly grim in Bangladesh since loss-of-activity of affordable and well-tolerated drugs might mean a hike in mortality. The *E. coli* isolates found in this study were susceptible to the common antibiotics, indicating reduced risk of therapeutic failure. However, lack of proper training, awareness and improper personal hygiene leads to contamination of street foods to continue and the public health risk to escalate [6].

In case of ready-to-eat foods all isolates of *E. coli* were β-glucuronidse positive. *Enterobactersakazaki* was found in Nan bread.*Citrobacterfreundii*was isolated from chicken samosa, lemon juice and sugarcane juice. Potential pathogen *Salmonella typhimurium* was isolated from singara and egg chop. The other important aspect of the identification of food pathogens is to assess the burden of multi-drug resistant pathogens. Simultaneous resistance against Ampicillin and Sulfamethoxazole makes it difficult to treat an infection. Successive spread in resistance poses a hazard of an epidemic

by resistant *E. coli* with a little therapeutic option. This could be particularly grim in Bangladesh since the infectivity of common, affordable and well-tolerated drugs might mean a hike in mortality. On the contrary to the published reports the *E. coli* isolates were susceptible to the common antibiotics, indicating a reduced risk of therapeutic failure. *E. coli* isolates were resistant against Ampicillin, Sulfamethoxazole and Tetracycline. Occurrence of β-glucuronidase positive strains means lesser risks because the Vero-toxigenic *E. coli* are often β-glucuronidase negative. The circumstance is more threatening in young children and the population. Presence of *E. coli* in processed and packaged food indicated poor handling and lack of adherence to good manufacturing practice by the local manufacturers [37, 38]. Awareness among food producers, consumers, retailers and the inspection authority might improve the situation of food safety in Dhaka city.*Campylobacter*spp. and*S.aureus* found to be sensitive toNalidixic Acid having 15% and 10% resistance respectively whereas highest susceptibility was found against Imipenem (80%). Most potent fecal coliform *E. coli* showed moderate level of sensitivityagainst Meropenem (60%), Azithromycin (45%), Streptomycin and Ciprofloxacin (both were 40%). Additionally NalidixicAcid, Vancomycin, Penicillin and Tetracycline were not effective against *E. coli* as it showed about 100% resistance. *Klebsiella* Spp. resistant to Tetracycline (100%),Streptomycin, Penicillin, Vancomycin (90%). *Salmonella* spp. showed the highest degree of resistance againstTetracycline, Vancomycin, Penicillin and Streptomycin (100%), followedbyRifampicin (95%), Meropenem (80%) and Azithromycin (75%). The other isolates *S. aureus* were found to be sensitive to Nalidixic Acid having 15% and 10% resistance respectively whereas highest susceptibility was found against Imipenem (80%). Most potent fecal coliform

showed moderate level of sensitivity against Meropenem (60%),Azithromycin (45%), Streptomycin and Ciprofloxacin (both were 40%). Additionally Nalidixic Acid, Vancomycin, Penicillin and Tetracycline were as it showed *Klebsiella* spp. was resistant to Tetracycline (100%) and streptomycin, Penicillin, vancomycin(90%). However, *Klebsiella* sp. isolates were sensitive to Imipenem (90%). *Klebsiella* isolates were sensitive to drug resistance profile of potential pathogens identified in this study is of concern [39].

The current study exhibited that, the microbiological quality of the ready-to-eat street foods available in Dhaka city expose the customers to high risk of acquiring food-borne diseases from multi-drug resistant bacteria pathogens. *E. coli*, *Salmonella typhi, Campylobacter* spp., *Vibrio* spp. are pathogenic bacteria which should be absent in food products. *S. aureus* causes food poisoning. Major reason for these food-borne pathogens to be present in food products are mainly due to unhygienic environment for food preparation, the use of contaminated water and ingredients, absence of awareness, training and practice of food sanitation by producers and handlers, disregard of food safety law in Bangladesh, lack of implementation of international standards from consumables goods (Hazard Analysis and Critical Control Point). Street food vendors should be trained and certified by food safety agencies before being able to start up a shop or food carts. Zones or specific locations should be isolated for street food sellers in Bangladesh around markets or shopping district with planning and permission of City Corporation. Regular inspection of food courts should be conducted by mobile courts consisting food specialist, microbiologist and nutritionist. Street food, food carts, food courts in markets should also come under jurisdiction. Food safety laws should

be implemented along with corrective actions and preventive measures. Keeping pace with the changing food habits in Dhaka city, the Bangladesh Food and Drug Authority could implement the Food Safety Law more effectively by instructing the retailers not to sell items without ISO9001 and BSTI approval. Consumers can be alerted about the poor quality of these products and children should be discouraged to consume these products. Raw fruits should be thoroughly washed well before consumption. A universal hand hygiene and hand washingpractice should be encouraged across all walks, ages and levels of society, emphasizing the benefits of simple practices that promote health.

References

1. Bondi M, Messi P, Halami PM, Papadopoulou C, de Niederhausern S. Emerging microbial concerns in food safety and new control measures. BioMed Research International [Internet]. 2014 July 06. [Cited 2021 November 05]; 251512: 3. Available from: https://www.hindawi.com/journals/bmri/2014/251512/. DOI: https://doi.org/10.1155/2014/251512
2. Teplitski M, Wright AC and Lorca G. Biological approaches for controlling shellfish-associated pathogens. Current Opinion in Biotechnology [Internet]. 2009 April. [Cited 2021 November 09]; 20(2):185–190. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0958166909000275?via%3DihubDOI: 10.1016/j.copbio.2009.03.001
3. Keusch GT, Fontaine O, Bhargava A, et al. Diarrheal Diseases. In: Jamison DT, Breman JG, Measham AR, et al., editors. Disease Control Priorities in Developing Countries. 2nd edition. Washington (DC): The

International Bank for Reconstruction and Development / the World Bank; 2006. Chapter 19. [Cited 2021 November 09]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK11764/

4. World Health Organization (WHO) [Internet]. Area of work: News/Fact sheets/Detail/Diarrhoeal disease; 2017 May 2; [Cited 11 November 2021] Available from:http://www.who.int/en/news-room/fact-sheets/detail/diarrhoeal-disease
5. Food Safety [blog on the Internet]. Consumer Association of Bangladesh. [Cited 2021 November 12]. Available from: https://www.consumerbd.org/food-safety/
6. Tambekar DH, Jaiswal VJ, Dhanorkar DV, Gulhane PB, Dudhane MN. Identification of microbiological hazards and safety of ready-to-eat food vended in streets of Amravati City, India. Journal of Applied Biosciences [Internet]. 2008 July [Cited 2021 November 09]; 7:195–201. Available from: http://www.m.elewa.org/JABS/2008/7/Abstract5-Tambekar.html
7. Khan RedzwanHabib. Understanding challenges faced by street food vendors to maintain street food hygiene in Dhaka City. Journal of Food and Nutrition Sciences [Internet]. 2016 June 4. [Cited 2021 November 9]; 4(4): 78-85. Available from: https://www.sciencepublishinggroup.com/journal/paperinfo?journalid=154&doi=10.11648/j.jfns.20160404.11DOI: 10.11648/j.jfns.20160404.11
8. Feglo P and Sakyi K. Bacterial contamination of street vending food in Kumasi, Ghana. Journal of Medical and Biomedical Sciences [Internet]. 2012 Mar. [Cited 2021 November 10]; 1(1):1-8. Available from:

https://www.ajol.info/index.php/jmbs/article/view/77101

9. SharmilaRane. Street vended food in developing world: Hazard analyses. Indian J. Microbiology [Internet]. 2011 January 26. [Cited 2021 November 10]; 51: 100-106. Available from: https://link.springer.com/article/10.1007/s12088-011-0154-x#citeasDOI:: https://doi.org/10.1007/s12088-011-0154-x
10. Isabella LN, Luciana OAM, Grazieli BP and Daurea AD. Nutritional issues concerning street foods. Journal of Clinical Nutrition and Dietetics [Internet]. 2016April 12. [Cited 2021 November 10]; 2(1): 1-9. Available from:https://clinicalnutrition.imedpub.com/nutritional-issues-concerning-street-foods.pdfDOI: http://dx.doi.org/10.4172/2472-1921.100014
11. ShubhangiKhare, AnshikaTonk, Anita Rawat. Foodborne diseases outbreak in India: A Review. International Journal of Food Science and Nutrition [Internet]. 2018 may. [Cited 2021 November 10]; 3(3):9-10. Available from: http://www.foodsciencejournal.com/archives/2018/vol3/issue3/3-3-21
12. Rashed Noor. Microbiological Quality of Commonly Consumed street foods in Bangladesh. Nutrition and Food Science [Internet]. 2016 February 8. [Cited 2021 November 10]; 46(1): 130-141. Available from: https://www.researchgate.net/publication/292947888_Microbiological_quality_of_commonly_consumed_street_foods_in_BangladeshDOI: https://doi.org/10.1108/NFS-08-2015-0091
13. Sultana S, Tarafder GH, Siddiqui TA, Sharma BC, Walliullah M, Ahmed T, Munna MS, Noor AF, Popy

SK, Das KK, Acharjee M, Urmi NJ, Rahman T and Noor R. Microbiological quality analysis of shrimps collected from local market around Dhaka city. International Food Research Journal [Internet]. 2013 September 26. [Cited 2021 November 10]; 21(1):33-38. Available from: http://www.ifrj.upm.edu.my/ifrj-2014-21-issue-1.html

14. Fernandez-Segovia I, Perez-Llacer A, Peidro B and Fuentes A. Implementation of Food Safety Management Systems according to ISO 22000 in the Food Supplement Industry: A Case Study. Food Control [Internet]. 2014 March 5. [Cited 2021 November 10]; 43:28-34. Available from: https://www.sciencedirect.com/science/article/abs/pii/S095671351400111XDOI: 10.1016/j.foodcont.2014.02.042.
15. Nyenje ME, Odjadjare CE, Tanih NF, Green E and Ndip RN. (2012) Foodborne Pathogens Recovered from Ready-to-Eat Foods from Roadside Cafeterias and Retail Outlets in Alice, Eastern Cape Province, South Africa: Public Health Implications. Int J Environ Res Public Health [Internet]. 2012 July 27.[Cited 2021 November 10]; 9(8): 2608–2619. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3447576/DOI: 10.3390/ijerph9082608
16. Kinman LA, Garcia MBM, Speshock J and Harp RM. Presence of pathogenic bacteria in ground beef during consumer thawing and food-handling habits. J Food Microbiology [Internet]. 2018 October 26. [Cited 2021 November 10]; 2(2):12-14.Avalible from: https://www.alliedacademies.org/articles/presence-of-pathogenic-bacteria-in-ground-beef-during-consumer-thawingand-foodhandling-habits.pdf

17. Kam Kai Man, Tsang Dominic, Yuen Kwok Yung. Microbiological guidelines for ready to eat food-Recommendations for Food Safety Monitoring in Hong Kong. Food and Environmental Hygiene, Department of Hong Kong. Report of the Food and Environmental Hygiene Department, Hong Kong [Internet]. 2002 February [Cited 2021 November 10]; 1-6. Available from: https://www.cfs.gov.hk/english/food_leg/files/ready-to-eat-food.pdf
18. NguendoYongsi HB. (2018) Eating to Live or Eating to Damage One's Health: Microbiological Risks Associated with Street-Vended Foods in a Subtropical Urban Setting (Yaoundé-Cameroon). Nutri Food SciInt J.[Internet]. 2018 May [Cited 2018 May 22]; 6(4): 555695. Available from: https://juniperpublishers.com/nfsij/NFSIJ.MS.ID.555695.phpDOI: 10.19080/NFSIJ.2018.06.555695
19. Banik A, Mohammad N, Akter T, Fatema K and Abony M. Prevalence, identification and antibiotic susceptibility of Enterococcus species isolated from chicken and pigeon meat in Gazipur Area, Bangladesh. Open J Med Microbiology [Internet]. 2018 September 18. [Cited 2021 November 10]; 8(3):307-10. Available from:https://www.scirp.org/journal/paperinformation.aspx?paperid=87370 DOI:10.4236/ojmm.2018.83007
20. Bangladesh Standards Testing Institute (BSTI) Standards Catalogue 2018 [Internet]. [Cited 2021 November 10] Available from: catalouge (bstibds.com)
21. Health Protection Agency. Guidelines for Assessing the Microbiological Safety of Ready-to-Eat Foods. London: Health Protection Agency [Internet]. November 2009. [Cited 2021 November 12]. Available

from:https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/363146/Guidelines_for_assessing_the_microbiological_safety_of_ready-to-eat_foods_on_the_market.pdf

22. Commission of the European Communities. Guidance document on official controls, under Regulation (EC) No 882/2004, concerning microbiological sampling and testing of foodstuffs. Health and Consumer protection Directorate-General, Brussels [Internet]. 2006 November 13. [Cited 2021 November 11]. Available from: https://ec.europa.eu/food/document/download/260e088d-6627-4f2c-af83-87ea4458233b_en
23. Gowrishankar S, Poornima B and Pandian SK. Inhibitory efficacy of cyclo (L-leucyl-L-prolyl) from mangrove rhizosphere bacterium-*Bacillus amyloliquefaciens* (MMS-50) toward cariogenic properties of *Streptococcus mutans*. Res Microbiology [Internet].2014 April 1. [Cited 2021 November 10]; 165(4): 278-89. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0923250814000321?via%3DihubDOI: 10.1016/j.resmic.2014.03.004
24. D H Bergey; John G Holt. Bergey's Manual of Determinative Bacteriology (ed. 9) [internet]. Philadelphia :Lippincott-Williams Inc.2000 [Cited 2000]. Available from: https://www.biodiversitylibrary.org/item/41848#page/7/mode/1up
25. Gomez-Gil B. et al. The Famlily *Vibrionaceae*. In: Rosenberg E., DeLong E.F., Lory S., Stackebrandt E., Thompson F. (eds) The Prokaryotes. Springer, Berlin, Heidelberg [Internet]. 2014 October 11. [Cited

2021 November 12]. Available from: https://link.springer.com/referenceworkentry/10.1007/978-3-642-38922-1_225#citeasDOI: https://doi.org/10.1007/978-3-642-38922-1_225

26. Bauer AW, Kirby WM, Sherris JC and Turck M. Antibiotic susceptibility testing by a standardized single disk method. American journal of Clinical Pathology [Internet]. 1965 August 17. [Cited 2021 November 11]; 45(4): 493–496. Available from: https://academic.oup.com/ajcp/article-abstract/45/4_ts/493/4821085DOI: https://doi.org/10.1093/ajcp/45.4_ts.493
27. Clinical and Laboratory Standards Institute. Performance Standards for Antimicrobial Susceptibility Testing; Twenty-Fifth Informational Supplement. CLSI document M100-S25. Wayne, PA: Clinical and Laboratory Standards Institute [Internet]. 2015 January 1 [Cited 2021 November 11]; 35(3). Available from: http://file.qums.ac.ir/repository/mmrc/CLSI2015.pdf
28. EkhlasUddin M, Akter T, AnowarKhasruParvez M, Nahar S, Pervin S, Debnath B, Datta S. Microbial Safety of Street Vended Fruit Juices in Dhaka City of Bangladesh. JAMB [Internet]. 2017 May 29 [Cited 11Nov.2021]; 3(2):1-7. Available from: https://www.journaljamb.com/index.php/JAMB/article/view/3903 DOI: 10.9734/JAMB/2017/33651
29. Mahfuza I, Arzina H, Md. Kamruzzaman M, Afifa K, Md. Afzal H, Rashed N and Roksana H. Microbial status of street vended fresh-cut fruits, salad vegetables and juices in Dhaka city of Bangladesh. International Food Research Journal [Internet]. 2016

January 6. [Cited 2021 November 10]; 23(5): 2258-2264. Available from: http://ifrj.upm.edu.my/ifrj-2016-23-issue-5.html

30. Tabashsum Z, Khalil I, Nazimuddin M, Mollah AKM, Inatsu Y and Bari ML. Prevalence of foodborne pathogens and spoilage microorganisms and their drug resistant status in different street foods of Dhaka City. Agriculture, Food and Analytical Bacteriology [Internet] 2013. [Cited 2021 November 10]; 3(4): 281-292. Available from: https://www.magcloud.com/browse/issue/684246
31. AHMED D, HOQUE A, ELAHI MSB, ENDTZ HP, HOSSAIN MA. Bacterial aetiology of diarrhoeal diseases and antimicrobial resistance in Dhaka, Bangladesh, 2005–2008. Epidemiology and Infection [Internet]. Cambridge University Press; 2011 November 11. [Cited 2021 November 12]; 140(9): 1678–1684. Available from: https://www.cambridge.org/core/journals/epidemiology-and-infection/article/bacterial-aetiology-of-diarrhoeal-diseases-and-antimicrobial-resistance-in-dhaka-bangladesh-20052008/EA3ADE9BDA5A4BE03E1082DF363CC4A9 DOI: 10.1017/S0950268811002135
32. Akinnibosun, F.I. and Ojo K.N. Comparative study of ready-to-eat foods from road-side and eateries in Benin City, Nigeria." African Journal of Microbiology Research [Internet]. 2015 April 1[cited 2021 November 12]; 9(13):929-933. Available from: https://academicjournals.org/journal/AJMR/how-to-citearticle/131B7B052149DOI:https://doi.org/10.5897/AJMR2015.7418

33. Chowdhury, FouziaFerdous Khan; Acharjee, Mrityunjoy; Noor, Rashed. Maintenance of Environmental Sustainability Through Microbiological Study of Pharmaceutical Solid Wastes. Clean-Soil Air Water [Internet], 2016 March 1 [Cited 2021 November 11]; 44(3): 309-316. Available from: https://www.researchgate.net/publication/280094182_Maintenance_of_Environmental_Sustainability_Through_Microbiological_Study_of_Pharmaceutical_Solid_WastesDOI: 10.1002/clen.201400777
34. TahminaShammi. Detection of *Vibrio* spp., *Salmonella* spp. and *Shigella* spp. among the frozen food samples employing enrichment culture technique. Stamford J. Microbiology [Internet]. 2016 March 01 [Cited 2021 November 11]; 5(1): 26-29. Available from: https://www.banglajol.info/index.php/SJM/article/view/26917DOI: https://doi.org/10.3329/sjm.v5i1.26917
35. NishatSarker, Sharmin Islam, MehediHasan, FarzanaKabir, Md. AftabUddin, Rashed Noor. Use of Multiplex PCR Assay for Detection of Diarrheagenic Escherichia Coli in Street Vended Food Items. *American Journal of Life Sciences* [Internet]. 2013 December 20. [Cited 2021 November 11]; 1(6): 267-272.Available from: https://www.sciencepublishinggroup.com/journal/paperinfo.aspx?journalid=118&doi=10.11648/j.ajls.20130106.15DOI: 10.11648/j.ajls.20130106.15
36. Das SK, Ahmed S, Ferdous F, Farzana FD, Chisti MJ, Latham JR, Talukder KA, Rahman M, Begum YA, Qadri F, Faruque ASG and Ahmed T. Etiological diversity of diarrhoeal disease in Bangladesh. J Infect

DevCtries [Internet]. 2013 Dec. [Cited 2013 December 15]; 7(12): 900-909. Available from: https://jidc.org/index.php/journal/article/view/24334935 DOI: 10.3855/jidc.3003

37. Cristina Paiva de Sousa. The impact of food manufacturing practices on food borne diseases. Braz. arch. biol. technol. [Internet]. 2008 August 26. [Cited 2021 November 11]; 51(4): 58-64. Available from: https://www.scielo.br/j/babt/a/VVgFpKTpHVkF6M4rHmH4tYr/?lang=enDOI: https://doi.org/10.1590/S1516-89132008000400020
38. Malavi ND, Muzhingi T and Abong GO. Good Manufacturing Practices and Microbial Contamination Sources in Orange Fleshed Sweet Potato Puree Processing Plant in Kenya. International Journal of Food Science [Internet]. 2018 April 2. [Cited 2021 November 11]; 4093161: 1-11. Available from: https://www.hindawi.com/journals/ijfs/2018/4093161/DOI: https://doi.org/10.1155/2018/4093161
39. Biswajit M, Rahman SM, Gazi MS, Uddin MA and Rahman T. Antimicrobial potency assay of common antibiotics collected from different drug stores in Dhaka Metropolis. Stamford J Microbiology [Internet].2013 November 17. [Cited 2021 November 11]; 3(1):26-29. Available from: https://www.banglajol.info/index.php/SJM/article/view/22749DOI: https://doi.org/10.3329/sjm.v3i1.22749

OMBUDSMAN: COMPARATIVE ANALYSIS OF AN OFFICE OF THE REDRESSAL OF PUBLIC GRIEVANCES GLOBALLY

Dr. SONY KULSHRESTHA
Associate Professor, Department of Law
Manipal University Jaipur, Jaipur, Rajasthan

Abstract

Every government has three organs: i. The Executive ii. The Legislature and iii. The Judiciary. The role of executive is to regulate functions of the government; the role of legislature is of law making; and interpretation of the law is the role of judiciary. Executive further delegate it's day-to-day work to some administrative authorities. There are few bodies who are appointed as administrators to check: whether the laws are fulfilling its purpose or not; whether people are following the laws or not or whether the administrators are performing their duties in a manner prescribed or not. To maintain the trust of public/citizens in the government, the fairness and accountability is important. To check the performance of administrators who are answerable towards individuals or public at large, there is an institution called 'Ombudsman'. In this article, the researcher has highlighted the objective of introducing the office of ombudsman, its functions, its rate of success and the scope of improvement of the functioning. The research has covered the structure and functioning of ombudsman in Sweden, UK, Scotland and India to understand the significance of the office of the ombudsman in better way. Secondary data have been referred and explored to conduct this research.

Keywords: *Complaints, Investigation, Maladministration, Lokpal, Redressal*

Introduction

The ombudsman is appointed by the government to represent the public. The main function of office of the ombudsman is to investigate the complaints against

malfunctioning of administration and matters related to infringement of rights.

For a country to thrive and create it needs to have a sorted out arrangement of organization, a framework which tries to review the issues of the individuals and above all, is liberated from debasement. Maladministration prompts different hindrances in the advancement of a country. The main driver of this issue of maladministration is debasement. The organization of "ombudsman" acted the hero and end up being of colossal significance and has been is as yet being received by different countries to secure the privileges of the person against the authoritative acts of the State and furthermore to dodge wastefulness in the regulatory set up of the State.

Garner defines "He is an officer of Parliament having as his primary function, the duty of acting as an agent for Parliament, for the purpose of safeguarding citizens against abuse or misuse administrative power by the executive "[1].
Origin of the concept can be traced from 18th century in Sweden. Sweden was the first country to introduce the ombudsman culture.

Origin of Ombudsman – Sweden

In 1713, King Charles XII of Sweden went to Turkey for about 13 years and in his absence his administration came to a big down fall. He therefore, decided to make a supreme Ombudsman representative in Sweden. The main function of this was to control, check and confirm the regulations abided by the judges and official, who are disregarding and are creating mal-administration. In 1809, Sweden was the first country to establish a Parliamentary Ombudsman. Now they

called it justitiekantsler- Chancellor of Justice. The justititeombudsman performs the same duties and powers provided by the Chancellor of Justice [2].

The Parliamentary Ombudsman (PO) covers all central and local government agencies and bodies but does not include members of Parliament. There are 4 PO's elected for 4 years by standing constitutional committee. Any complainants to be submitted in writing to the Justititeombudsman (JO). Some 5000 cases are handled every year and 40% are unfound at early stage. JO has full freedom to decide the investigation cases. Now, it is JO's duty to inspect from time to time the authorities. The cases can go on long term investigations. The cases taken up in courts work on the concept of independence of judiciary but the JO would look in matter whether the judges are working legally and does not violate. If found an error the JO would give some serious critical statements. and such opinions we might see in 600 JO decisions which represent 1/4th investigations [3].

Features of Sweden Ombudsman

1) There is a high degree of independence in terms of the working of JO and free from executive intervention.
2) It has power to investigate and have access to documents and materials.
3) It has power to recommend not forcefully but it believes in transparency and credibility.
4) It presents annual report to the Parliament. In Parliament it can discuss the shortcomings and gaps in the regulatory and executive system.
5) The report is examined by Standing Parliamentary Committees and contents are checked and the committees provide statement of opinion.

Origin of Ombudsman - United Kingdom

In 1950's, there rose an urgent need of Ombudsman, because there was an increasing concern in administration in UK. In 1954, the idea came up through a Crichel Down affair. The matter was that during World War Second about 725 acres of land was taken by Air Ministry with the promise to return it to the land owner. In its place the land was given over to the Agriculture Ministry. This case came up as an example of mal-administration. The British Section of the International Commission of Jurists, JUSTICE published a report which stated that:

"… a continuous flow of relatively minor complaints, not sufficient in themselves to attract public interest, but nevertheless of great importance to the individuals concerned, which give rise to feelings of frustration and resentment because of the inadequacy of the existing means of seeking redress" [4].

Taking this in mind the *Parliamentary Commissioner Act of 1967* (PCA, 1967) was passed, Parliamentary Commissioner was appointed for administrative works. The PCA is appointed for 7 years [5].

Features of PCA-

1) They investigate the complaints made by citizens against public bodies.
2) They design the working to redress the difference and act as an expert.
3) Access to Ombudsman is free to the citizens.
4) Ombudsman tries to attain an unbiased resolution at the earliest.

5) They use the flexible methods during the procedures like resolving the cases through mediation, recommendations.
6) They equally investigate the facts and search for evidence.
7) An annual report containing the work, their statistics and method to solve the problem is published.

Beside these actions there is one lacuna in the power of the Parliamentary Commissioner that he is not able to award any remedy and there can be a judicial review of the findings of the Ombudsman.

Origin of Ombudsman: Scotland

In Scotland the concept was introduced by The Scottish Public Services Ombudsman Act (SPSO), 2002 [6]. Key features are as follows:

1) It removed the need for complaints to go through Member of Scottish Parliament (MSPs).
2) Provides the scope of representative complaint means a complaint made on behalf of other person.
3) Allows complaints to be accepted in oral form.
4) It made the publication of reports of investigation compulsory.
5) It has given the power to the office of ombudsman to highlight/ publicize the unsolved cases means where the justice was not given due to some issues.

The working of SPSO is effective but its message delivery system needs more attention and clarity.

Origin of Ombudsman: India

A commission named 'Administrative Reforms Commission' was set-up in 1966, based on the concept of ombudsman. This was the result of many reported cases on mal-administration, where the solution was untouched. In India we use the terms Lokpal and Lokayukta for office of ombudsman. Where Lokpal is centra office and Lokayukta is state office. In the present scenario we have an Act called Lokpal and Lokayukta Act, 2013 [7].

Need of Lokpal

Situation before the enforcement of the Act [8] :

- Despite the sufficient evidences no imprisonment or punishment for political person or officer of senior grade. Reason was that the CBI and other investigation bodies were directly came under the purview of government.
- Central Vigilance Committee was only the advisory committee, if it advised to start investigation or dismiss the services of any officer, the government took it as advice only.
- Due to rigorous procedure any action against any judge was impossible to take.
- Even in CBI and CVC number of corrupt practices were evident.
- Bribery was so common.
- Anti-corruption department was headed by weak and corrupt people.

Need of Lokpal

Situation after the enforcement of the Act [9]:

- Lokpal and Lokayukta are free bodies. ACB and CBI will be converted into these bodies. Capacity to start examinations against any official or legislator without requiring anyone's authorization.
- Lokpal and Lokayukta are having comprehensive controls to order dismissal of a corrupt officer.
- Lokpal and Lokayukta will have forces to research and arraign any adjudicator without requiring anybody's consent.
- All examinations in the Lokpal and Lokayukta will be straightforward. After finish of examination, all case records will be available to open.
- Government officials will have definitely no privilege in determinations of Chairperson and individuals from Lokpal and Lokayukta and choices will occur through a straightforward and open participatory procedure.
- Lokpal and Lokayukta will get open complaints settled in time bound way, forced a punishment of Rs 250 every day of postponement and that will be cut from pay of blameworthy official and grant that sum as remuneration to the distressed resident.

Lokayukta (at State level)

The institution of Lokayukta has been established in several states by enacting statute in the State Assemblies. These states are; Orissa (1970), Maharashtra (1971), Rajasthan (1973), Bihar (1973), Madhya Pradesh (1975), Uttar Pradesh (1975), Gujarat (1975), Karnataka (1979), Andhra Pradesh (1983), Himachal Pradesh (1983) [10].

Conclusion:

In current legal framework, throughout the whole world, there is no specific and effective legal system. All the countries are facing the same administrative problems. Roots of corruption is so deep that it will take a lot more time to eradicate. The biggest problem is that prevention of corruption methods; people are not aware. And still to secure themselves they use wrong methods to be done. So people should alert themselves and should create an awareness about the importance of Lokpal. The proposition for the Lokpal right now neglects to address this center issue and hence will undoubtedly neglect to accomplish its basic role: the criminal conviction of degenerate authorities. And if there is a public demand, definitely the legislation is bound to initiate itself. Because in today's scenario, public had lost faith in working of the system. So, to gain confidence the legislation and the Judicial system together come out with strong compact laws and rules. If people are not coming forward to file the complaints or for raising the issues, the law cannot be fruitful. They should raise issues through media and file complaint against the corrupt people. In the present scenario we don't have any law for corporate sector and for private sector to take care of the matters or to take cognizance of the matters related to these sectors. Now, it is a high time to think about the nation.

Suggestions:

1) The most common problem researcher realized was that in most states they do not have sufficient staff and do not have an independent investigating team. So, the government should provide a team or collaborate CBI's and ACB's with Lokayukta for more effective and promising results.

2) There should be transparent and open procedures for the appointment of the Ombudsman so that there should not be the misuse of the power.
3) Just like RTI, where people through media and the efforts of government make people aware the usage of it. In the same way, Lokayukt should be given attention and more awareness should be spread.
4) The investigation should be done in a secret way so that less interference of political parties and corrupt high level of officers could be seen.
5) A strong suggestion to the legislation to frame a strong and comprehensive law where the punishment could be minimum for 5 years and maximum as life imprisonment. In rarest cases, death penalty could be served.
6) All Public servants including the Chief Minister in Lokayukta and at center the Prime Minister should be within the jurisdiction.
7) There should be Fast Track courts to complete the cases within the time limit of 6 months. And cases should be tracked online. Every detail of the case should be verified and open to public.
8) Some strong laws should even be made for private companies and private employees in terms of corruption.
9) The provisions of e- governance should be promoted to deal with the corruption matters.
10) The post of Lokpal should be filled as soon as possible. The central government should take necessary decisions and arrangements.

References

1. Garner definition "Administrative Law- S.R. Myneni", Asia Law House, 2017.
2. Peter Leyland and Gordon Anthony "Administrative Law", Oxford University Press, 2012.
3. M.P.Jain and S.S.Jain "Principles of Administrative Law, Lexis Nexis, rev.by Justice D.M. Dharmadhikari, 8th edition, 2016.
4. Hilaire Barnett "Constitutional & Administrative Law", Taylor & Francis, pg. No. 726, 2017.
5. Dr. S.A.Karandikar and Dr. V. Bindu "Constitutional and Administrative Law", Aarti & Co., Mumbai, 2019.
6. M. Salim Malik "A Comprehensive Analysis of the Law of the Ombudsman", Aberdeen University Press Services, 2018.
7. L.B.Hill " The Model Ombudsman" Princeton University Press, 1977.
8. Ziegenfuss James T. "The Ombudsman Handbook", McFarland & Co Inc, 2nd edition, 1999.
9. Reif Linda C. "The Ombudsman, Good Governance and The International Human Rights System", Brill, 2011.
10. Trevor Buck "The Ombudsman Enterprise and Administrative Justice", Taylor & francis, 2017.
11. http://shodhganga.inflibnet.ac.in/bitstream/10603/74300/17/17_chapter%208.pdf
12. https://thelawblog.in/2016/12/18/status-of-lokayukta-act-in-india/
13. http://www.indianresearchjournals.com/pdf/IJSSIR/2012/June/1.pdf
14. http://www.dnaindia.com/mumbai/report-only-7-cases-at-lokayukta-related-to-graft-2228718

15. http://www.dnaindia.com/mumbai/report-dna-exclusive-toothless-maharashtra-lokayukta-deals-mostly- with-service-issues-1933024
16. http://www.dnaindia.com/jaipur/report-rajasthan-lokayukta-submits-32nd-annual-report-to- governor-2595997
17. http://www.rajras.in/index.php/lokayukta-in-rajasthan/
18. http://www.accountabilityindia.in/sites/default/files/the_kerala_ombudsman.pdf
19. http://www.thehindu.com/todays-paper/tp-in-school/all-about lokayukta/article4270895.ece
20. http://azimpremjiuniversity.edu.in/SitePages/pdf/epw-16961.pdf
21. https://lawlex.org/lex-bulletin/ombudsman-system-a-battle-won/9112
22. http://www.financialexpress.com/india-news/maharashtra-lokayukta-closed-1863-complaints-since-2014-with-no-action-rti/360729/

INFLUENCE OF KARL MARX ON TWENTIETH CENTURY LITERATURE: A SCHOLARLY INVESTIGATION

Dr. ARUN DEV PAREEK
Assistant Professor, Department of Languages,
Manipal University Jaipur, Jaipur-303007, Rajasthan, India.

Abstract

Marxist philosophy has developed over time. It has worked as a phenomenal force and has changed the entire world order. The class struggle and the exploitation of rights had been a common practice in most of the societies across the globe over centuries, but the word gained attention and popularity, when Karl Marx & Friedrich Engels discussed the same in their works. Even Darwin's concept of the survival of the fittest has traces of struggle for supremacy, survival and existence. As literature reflects life, so this philosophy of Karl Marx became a common theme in all genres of literature. All types of struggles, whether in open or hidden form, have been portrayed by writers to make the readers understand the socio-economic structure of any society or country. Literature of the Blacks is also an outcome of one such struggles in the human society. The struggle and exploitation faced by the characters are quite real, when portrayed in story forms. The characters are exploited and disrespected at a given point of time point in their lives, and the works keenly present the trauma of suppression and oppression of the suppressed class in the society. Exploratory and descriptive research methods are used for deriving the theoretical analysis and results.

Keywords: *Marxism, Exploitation, Literature, Struggle, Identity*

Introduction

I think, to begin with 'Ideology' will serve a better purpose to understand Karl Marx. If we go through the title and the term 'ideology', many questions may arise in our mind – What is Ideology? What significance it has, if related to Marx? How does it influence literature? If we try to define the term

'ideology' in a nut-shell, we can say that it's an idea which prevails in the culture. The *Longman Dictionary of Contemporary English* defines "ideology" as "a set of ideas on which a political or economic system is based." [1] In general, 'ideology' is a social consciousness that prevails during a specific period in a definite class. It includes all the political, moral, legal, philosophical, and other views and ideas of a specific class. For example, Socialism is an ideology (of the working class) which advocates the abolition of private property. In the *German Ideology*, Karl Marx and Friedrich Engels speak about 'ideology'. They say, "…the ideas of the ruling class are in every epoch the ruling ideas: i.e., the class which is the ruling material force of society is at the same time its ruling intellectual force." [2]

Discussion

Marx elaborates that all kinds of social activities (political, religious, philosophical, moral, art, science, etc.) generated by an economic base (the mode of production) work to justify that economic base. For example, the ideologies of a capitalist society will justify the capitalist mode of production. Marx makes effort to construct a method of social analysis that would achieve a better understanding of the development of the human condition and, with this understanding, human mind could move towards an association in which the free development of each is the condition for the free development of all. The ideology of Marx aims to improve human relations in the world and, advocates eternal peace and freedom. His companion, Friedrich Engels, treats ideology as an illusion, which creates false consciousness in people. He suggests that the workers think they're not exploited by the capitalist system. The reason which Engels gives, for such an outlook is,

they're deluded by various kinds of ideology, which results in misperceiving. Ideology prevents individuals from seeing how society actually functions.

Literature also serves in the same way as an ideology does. As a cultural production, literature is a form of ideology, which creates illusion and prevents people from perceiving reality to great extent. It works on the prevailing ideologies of a particular age. Marxist literary critics look at literature as a social power. The role of 'Marxism' in regard to literature as described by Edmund Wilson, is to "throw a great deal of light on the origins and social significance of works of art". [3]

Karl Heinrich Marx, better known as Marx, produced many important works in joint venture with Friedrich Engels. The philosophy of G. W. F. Hegel, deeply influenced Marx. He derived many of his ideas from Hegel, viz. his idea of 'dialectical materialism'. According to Hegel's concept of 'dialectic', no ideas, social formations or practices were ever eternal or fixed, but were always in motion. Hegel explained that the ideas themselves evolve through a constant process of 'contradiction' and 'resolution', and the human history is governed by this dialectical evolution of ideas. 'Dialectical materialism' as a branch of philosophy of Marx, is a complete system of knowledge, a world-view. This philosophy, as defined by Shanta in *Marx and Contemporary Materialism* is: "… the world view of the working class. As basically scientific and uniquely true philosophy, Dialectic Materialism currently constitutes the progressive world-view of all progressive humanity. It is the science which studies the relationship of knowledge to the objective material world, as well as the most general laws of the movement and development of nature,

society and thought …. It represents the organic unity of materialism and dialectic…." [4]

The basic law of dialectic materialism gives a general picture of the development of the world, and its transformation. The transformation is the outcome of human consciousness. Taking Rene Descartes' famous philosophical statement 'I think, therefore, I am', into account, Marx believed that a person's consciousness is not shaped by some spiritual entity or pre-existing mind. Through daily living and interacting, humans define themselves. The basic law of Marxist dialectics is the unity and struggle of the opposites, which results in the development of the material world (nature, society, and thought).

Marxism is a kind of historicism, i.e. 'Historical Materialism'. It is the Marxist way to understand history. Historical materialism is 'materialistic' in nature because it focuses on how humans have created material culture i.e. objects, tools, materials for their daily needs and household uses, etc., and how this 'material culture' has formed the basis for the historical change. Marx saw history as a chain of economic systems/modes of production, made to satisfy the human demands, but giving rise to antagonisms between different classes, resulting in the formation of new classes and societies. V. Afanas'ev defines 'historical materialism' as "the study of society and the laws of its development." [5]

Marx identifies four major stages of historical development

1. Feudalism: a period of slavery and inherited wealth;
2. Capitalism: a period of ownership of private property;
3. Socialism: a transitional period;
4. Communism: a period of equality.

Marxists believe that the historical development or social change occurs due to class struggle (i.e. the struggle between the proletariat and the capitalist). In a capitalist mode of production, a worker is deprived of self-worth and identity and is alienated from the products he creates. The worker is also estranged from his own humanity. He regards the product, which he creates, only as a means of survival. This very concept is known as 'alienation'. The alienation of the proletariat, and their exploitation by the Capitalist system, form the basic contradictions of capitalism, which give rise to dialectic (the struggle between the two classes) and results in social change (history). Marx's economic doctrines come down to us from his famous work *Capital*. It measures how the capitalist system specifically functions. [6]

Literature, as part of the superstructure, reflects the dialectical struggle. Literature produced in the fifteenth and the sixteenth centuries depicts the themes of feudalism, whereas, twentieth century literature reflects the economic and social disorder in the society. Avtar Singh in his article "Marxist Conception of the Base-Superstructure" explains the viewpoints of Marx and Engels towards 'art' and 'literature': "Marx and Engels see art and literature as aspects of social consciousness and consider it impossible to understand them as proceeding only from their internal laws of development. In their opinion, the essence origin, development and social life of art could only be understood through analysis of the social system as a whole in which the economic factor plays the decisive role." [7] Literature produced in any era, directly or indirectly, depicts the society of that age.

The ideologies and the doctrines of Marx has become a very prominent movement in art and literature. Marxism

influenced both a writer and a critic. It was in the twentieth century that the entire world registered and acknowledged the Marxist viewpoint. No single nation is to be found without the Marxist ideologies. The new writers and critics who entered the literary panorama, was directly or indirectly linked to Marxism. Not only the Russian writers and critics, but also the literary figures living in Germany, America, England and the 'third-world countries', were greatly influenced by the doctrines of Marx. The literary critics and authors like, Terry Eagleton, Raymond, Williams, David Craig, Leon Trotsky, Maxim Gorky, W. H. Auden, George Orwell, György Lukacs, etc. adopted the Marxist thinking.

The Russian, German and American writings are also filled deep with the doctrines and ideologies of Marx. Playwrights like Maxim Gorky and Leonid Andreyev carry on the Marxist outlook within their works. Leo Tolstoy in his play *The Power of Darkness*, creates a famous character 'Akim', who works as the mouthpiece for Tolstoy. 'Akim' is the loud denouncer of the evils of capitalism who speaks up for the downtrodden masses. He dreams for 'communism'. Even in the field of Indian literature, mostly the writers from Bengal, adopted the Marxist themes in their works. Names like Bhabhani Bhattacharya, Harindranath Chattopadhyaya etc. portrayed the proletarian conditions under the capitalists. Bhattacharya's *So Many Hungers* expresses the ruthlessness of the capitalists and black marketeers.

If we read the works of W. H. Auden, we find in his early poems (during his stay in England) written during the inter war years, a feeling of violent social reforms. The economic disturbances of the 1930s. made Auden the mouth piece of the proletariat. The period of the 1930s was the period of social

disorder. To quote B. Prasad: "The 1920s were years of tremendous political upheaval and social change. In 1922, Mussolini came to power in Italy, in 1926 the General strike paralyzed Britain, in 1929, the Wall Street crashed and similar financial chaos continued in the 1930's resulting in mass unemployment and semi-starvation in the industrial districts of Britain. This period saw the rise to power of fascist and Nazi dictatorships, the threat of war from Japan to Western Europe, Civil War in Spain …." [8]

During this period Auden turned to become the hero of the 'Left'. The Macspaunday Group, to a great extent, highlighted the social conditions in their works. Auden's poem "September 1939" is deeply concerned with the economic and social disorder of 1930s. Writers like Balzac, Tolstoy, Bertold Brecht, etc. in order to record the conditions of the society, adopted an indirect way. They created characters through which they poured out their own sentiments. Toni Morrison, an Afro-American writer, through her works, looks at poverty and class oppression from the eyes and minds of the poor and the proletariat. Her novels like, *The Bluest Eye*, *Sula*, *Tar Baby*, *Jazz*, depict the problem of gender and class. We find in her works, the condition of 'Blacks' as that of the 'Proletariats', and of 'Whites' as that of the 'Capitalists'. Even the lyric poetry, which is concerned with the personal emotions of the poets, in the twentieth century, carries on the Marxist outlook. Elizabeth Bishop, a poet of the 1930s, evokes the bread lines of the 'depression' when unemployment and homelessness ruled the world. Bishop lays emphasis on the economic distress through her poem "A Miracle for Breakfast". The poems of the postmodern period, also reflects the picture of the proletarian society. Tony Harrison and Douglas Dunn are two such poets.

Conclusion

The philosophy of Marx acted as the backbone of all revolutions and influenced the literary writings, which fused with the revolutions. The class struggle became the major themes of the twentieth century literature. Though, literature of all the preceding eras possessed such sentiments, yet the particular term 'the Marxist outlook' didn't come into force until the nineteenth century. It also provided background for the critics to study the old works of literature from the Marxist angle. Whether its Shakespeare's *King Lear* or Chaucer's *The Canterbury Tales*, all these works depict the picture of the ruling class. During the feudal period, literature mostly produced, portrayed the picture of the aristocratic class. It can thus be said that the political and economic ideology of Marx provided a new angle of studying and producing any literary work. Marxist critics used this ideology in studying literature and the writers registered his influence in their works. Thus, literature helps to create experience and uncover the inner workings of society.

References

1. "ideology", Def. 2. *Longman Dictionary of Contemporary English.* 6th ed. 2015.
2. Freiberg, J. W. Sociology and the Ruling Class. *Insurgent Sociologist*, *3*(4), 1973, p. 12. https://doi.org/10.1177/089692057300300402
3. Williams, R. *Marxism and Literature.* Oxford Paperbacks, 1977. p.246.
4. Shanta, *Marx and Contemporary Materialism*. Printwell, 1987. p.40.
5. Afanas'ev, V. G. *Marxist Philosophy: A Popular Outlook*. Progress Publishers, 1980. p.180.

6. Wilson, E. Marxism and Literature. *20th Century Literary Criticism: A Reader,* ed. David Lodge. Longman, 1975. p.6.
7. Singh, A. Marxist Conception of the Base Superstructure. *Indian Response to Literary Theories*, ed. R. S. Pathak Vol. I. Creative Books, 1996. p.164.
8. Prasad, B. *A Short History of English Literature*. 1971. rvd. By Manohar E. Samuel. Macmillan, 2001. pp.184-85.