A Review on *Salmonella* Characteristics, Taxonomy, Nomenclature with Special Reference to Non-Typhoidal and Typhoidal Salmonellosis

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**Abstract**

The genus *Salmonella* belongs to family *Enterobacteriaceae*. They possess interesting phenotypic/genotypic characteristics, history and peculiar nomenclature compared to other bacteria within and outside the family. The organism causes typhoidal salmonellosis (TS) and non-typhoidal salmonellosis (NTS), which exhibit different syndromes in man and animals and is of public health importance worldwide. This study reviewed the characteristics, taxonomy, nomenclature and nature of *Salmonella* in addition to the overview of NTS and TS. Baseline data/information published in peer reviewed journals, textbooks and bulletins/articles of international regulatory bodies were used for the study. The collective data of the present study revealed that *Salmonella* is a 2-3 X 0.4-0.6 µm sized, a Gram-negative rod, non-spore producing, oxidase, indole, urease, lactose and sucrose negative, facultative anaerobic and a motile organism. The two *Salmonella* species, that exist, only differ in their 16S rDNA sequences although both species are related closely to *Shigella* and *E. coli* at 16S rDNA and 32S rDNA sequences. *Salmonella* species and genus names are italicized; while more recently, the first letter of the serotype’s name is capitalized, but the word is not written in italics. *Salmonella* is the cause of NTS and TS in man and animals presenting enteritis, septicaemia, abortion and meningitis. Salmonellosis outbreaks had been reported from food, food products of animal origin and animal contact settings with cross infection between humans and animals. The disease in different parts of the world is among the public health challenges that are most common with reported increased incidence of many serotypes. The organism’s role as a major aetiology of foodborne disease and septicaemia resulting in morbidity and mortality worldwide had been highlighted. Continuous research on *Salmonella* and salmonellosis should be carried out to contribute to the body of knowledge on the organism, disease and ultimately improvement of preventive/therapeutic strategies of the disease.

**Keywords:** *Salmonella*, characteristics, history, nomenclature, NTS/TS

**Introduction**

The ubiquitous nature of *Salmonella* species (spp.) in the environment is fuelled by their abundance in the intestinal tract of animals, which serve as major reservoirs of the organism [1]. The transmission of the bacteria to humans is usually through ingested food and water [2]. *Salmonella* was first observed in the 1800s [3]. The organism was cultured in 1888 by Salmon and Smith [3]. The first reported case and isolation in humans was also in 1888 by Gartner [4]. More than 2600
Salmonella serotypes had been reported by White Kauffmann-Le Minor, 1600 of which belong to the subspecies enterica [5]. Over 200 serotypes of the organism had been reported to be able to cause diseases in humans [6]. Salmonella spp. belong to the family Enterobacteriaceae. They are Gram-negative rod-shaped organisms [7]. Kauffmann-White scheme reported Salmonella enterica (S. enterica) and S. bongori as the two major species of the genus [8, 9]. Other reported forms of classification are based on biochemical characteristics (S. Cholerasuis, S. Typhi and S. Enteritidis) [10] and host predilection (S. Typhi and S. Paratyphi-adapted to humans, Salmonella spp. adapted to specific animals; S. Cholerasuis-swine, S. Pullorum/S. Gallinarum- poultry and S. Dublin-cattle and Salmonella spp. not adapted to any host) [11].

Worldwide, foodborne diseases caused by Salmonella have been of public health concern for over a century [12]. Salmonella diseases are grouped into typhoidal salmonellosis (TS, enteric fever) and non-typhoidal Salmonella (NTS) associated infections [13, 14]. Salmonella enterica serovar Typhi causes typhoid fever and S. Paratyphi A, B and C cause human host restricted paratyphoid fever [13]. The cause of NTS infections is a group of S. enterica serovars [14]. Salmonella Enteritidis, S. Cholerasuis and S. Typhimurium are some of the serovars that cause diseases in humans through contamination and ingestion of food and food products [15]. While, invasive typhoidal salmonellosis causes enteric fever, gastroenteritis and bacteraemia [1]. Non-typhoidal salmonellosis presents majorly gastroenteritis, which is a condition that affects the ileum and colon with diarrhoea, abdominal cramp and vomiting as visible clinical signs/symptoms [16]. The aim of this study is to examine the characteristics, taxonomy, nomenclature and nature of Salmonella in addition to the overview of NTS and TS.

Materials and Methods

Baseline information on Salmonella characteristics, taxonomy, nomenclature and salmonellosis obtained from published work, textbooks and bulletins/articles of international regulatory bodies like Centre for disease Control (CDC) and World Health Organization (WHO) were collected by typing desired keywords into google search engine. Publications with relevant data and information were selected, saved and later retrieved for the study. Results were presented as texts, tables and figures.

**General characteristics of Salmonella**

Salmonella is one of the members of Enterobacteriaceae family. The organisms are negative to Gram stain and oxidase test and they are motile (due to the presence of peritrichous flagella), rod shaped, non-spore producing and facultative anaerobes [17]. Salmonella species are about 2-3 X 0.4-0.6µm in size [18-20]. Salmonella typically produces hydrogen sulphide, breaks down D-glucose to produce hydrogen and carbon dioxide, while nitrates are reduced to nitrites [20]. Except Salmonella serovar Typhimurium, which does not produce gas, almost all Salmonella serovars are aerogenic [21]. They test negative for both urease and indole (tryptophanase) production. Salmonella belongs to the Gamma proteobacteria class according to the sequence analyses of 16S rDNA gene [21, 22].

The cell wall of Salmonella comprises lipids, lipopolysaccharide, proteins and lipoproteins [23]. The lipopolysaccharide and the lipid portion of the cell wall contain the endotoxin, which is responsible for the biological effects of the bacteria [23]. The common centre polysaccharides and monosaccharides of the endotoxin are also called the somatic O antigen [23]. The somatic ‘O’ antigen is the polysaccharide portion on the surface of the bacteria, which consists of many short oligosaccharide [24]. In Salmonella, about 60 somatic antigens exist [24]. Genotypic analysis suggests the acquisition of the antigens through gene transfer, which are interspecific within the bacteria. These antigens are represented by numbers (Figure 1) [24]. Based on these somatic antigens, Salmonella can be divided into groups with the use of specific antisera [23]. Salmonella also possesses the flagella
‘H’ antigens. These are represented by both letters and numbers [23]. There are about 114 recognized H antigens [25]. The flagella H antigens are proteins that are heat labile [18]. They present in 1 or 2 phases; the specific or/and non-specific phases otherwise referred to as phase I or/and II H antigen [23]. Some Salmonella serovars produce heat sensitive carbohydrates surface ‘K’ antigens. In addition, Salmonella Typhi has virulence/capsular antigen enveloping its cell wall [26]. Based on the somatic and flagella agglutination reactions, about 2,463 serotypes were described at year 2000 (Table 1) [27] and the number has reportedly risen to 3000 in 2017 [28].

Salmonella readily grows on blood and MacConkey’s agar [29]. Bismuth sulfate agar (BSA), Salmonella Shigella agar (SSA), xyline lysine deoxycholate (XLD) agar could also be used for Salmonella isolation. On these agars, they ferment glucose and mannose, but not lactose and sucrose (Figure 2) [30, 31]. Salmonella serotypes grow optimally at temperatures between 35°C and 40°C. Based on growth matrix and the serovars involved, they can grow within the temperature range of 2°C - 54°C [22]. Temperatures that are very low do not support the growth of Salmonella [32]. However, freezing does not always have destructive effect on the organism, because of its hardy nature [33]. Most Salmonella serovars are resistant to dehydration and thrive well in acidic media of pH 1 - 4.6 [34]. The bacteria are heat stable and resistant to alcohol and dilute acid [20].

Salmonella as a genus only have two species; S. enterica and S. bongori (Table 2) with S. enterica being the most widely distributed in nature [8]. The sequence analysis of 16S rDNA further distinguishes S. enterica and S. bongori and affirms their close relatedness to the Shigella-E. coli complex by both 23S and 16S RNA sequence analyses [35].

Salmonella serovars possess peculiar and unique antigen combinations. This makes up the antigenic formula of each strain. The serotype name of each serovar is assigned based on the unique antigenic formula and the Kauffman – White scheme [36, 37]. Phage typing is another method used to differentiate and identify Salmonella serotypes [38], other established methods employed include PCR ribotyping, pulsed-field gel electrophoresis analysis, multilocus sequencing of DNA and patterns of antimicrobial resistance [39 - 42].

Kauffmann-white classification shows that majority of the Salmonella involved in diseases in humans are from Salmonella enterica subspecies I, II, IIIa, IIIb, IV, VI or A, B, C, C2, D and E [29, 43].

Most humans, domestic and wild animals harbour the bacteria in their gastrointestinal tract with no apparent signs of illness [44 - 46]. All over the world, Salmonella had been reported to be of significant economic and medical interest [47].

Taxonomy and nomenclature of Salmonella

Eberth first observed Salmonella in a patient that died due to typhoid fever in the year 1880 [48]. The organism was identified from the sections of mesenteric/spleen lymph nodes of the patient. At that time, the organism was known as Typoid bacillus [48]. The name Bacillus choleraesuis was thereafter given to the organism in the year 1884, when it was isolated from the intestine of pigs by D. E. Salmon, who was a bacteriologist from America [49, 50]. Lignieres subsequently changed the name of the organism to Salmonella Choleraesuis in 1900 in honor of D. E. Salmon [40]. Kauffmann in 1966, proposed one serotype one specie concept for the genus Salmonella based on the identification of O and H antigens [51-53]. This made each serotype separate specie. The application of this concept today will result in about 3000 species of Salmonella. Multiple Salmonella species thus existed and were taxonomically accepted before 1973 [54]. All these were however, classified under one type specie Salmonella Choleraesuis [55, 56]. The type specie was further divided into five subgroups based on genetic similarity. They are Salmonella Choleraesuis (type specie of the genus), S. Arizonae,which is now made up of S. Arizonae and S. Diarizonae, S. Enteritidis,
S. Typhi and S. Typhimurium [49, 57- 60]. This was published in 1980 in ‘the approved list of bacteria names’ [61].

Salmonella Choleraesuis in ‘the approved list of bacteria names’ appeared as ‘the type species’ of Salmonella. ‘Choleraesuis’ appearing on the list however, caused some confusion because it referred to a serotype and a specie at the same time [54, 56, 61]. The serotype is distinct in its biochemistry; it is arabinose and trehalose negative and does not represent the majority of the serotypes in the genus [54, 62].

In 1973, the defining moment in the taxonomy of Salmonella occurred in the work and report of Crosa et al. [55] who through the hybridization of DNA-DNA studies demonstrated that enterica, salamae, arizonae and houtenae (subgenera I, II, III and IV) were related at the specie level and are from the same specie with the exception of S. bongori, which is a distinct specie on its own [24, 54, 55].

Kauffmann and Edwards came up with the name ‘Enterica’ in the year 1952, because it is not shared by any other serotype [54, 62]. At the 14th International Congress of Microbiology, the Enterobacteriaceae subcommittee of the International Committee on Systemic Bacteriology unanimously recommended that S. enterica can be used as the type specie name of Salmonella [63]. In 1986, the Centers for Disease Control and Prevention (CDC) adopted the recommendation of the subcommittee. In 1987, LeMinor and Popoff of the World Health Organization (WHO) formally made a ‘request for opinion’ proposal to the Judicial Commission of the International Committee of Systemic Bacteriology [35, 64]. The request was however, not approved by the Judicial Commission due to concerns that the aetiology of typhoid fever, Salmonella Typhi, which causes a disease of utmost clinical importance, was not adequately addressed by the ‘request for opinion’ made by Popoff’s and Le Minor [65].

Euzebey made an amended request to the opinion in 1999 for S. enterica to be used as the type specie name with the exception of “S. Typhi”, which retains its specie name because of its clinical importance [65].

In 1987, LeMinor and Popoff proposed that the subgenera (subspecies) of Salmonella be referred to as enterica (I), salamae (II), arizonae (IIia), diarizonae (IIib), houtenae (IV), indica (VI) and bongori (VI) [35]. Based on biochemical reactions and antigenic relatedness, subspecies III was divided into 2 subspecies. Salmonella enterica subspecies Arizonae have serotypes with one phase, while Salmonella enterica subspecies Diarizonae have diphasic serotypes [54].

According to the recommendation of WHO Collaborating Center, the current system employed by the CDC recognized S. enterica and S. bongori as the 2 species in the genus Salmonella. Several serovars are named in the 2 species of Salmonella [35]. The WHO also described Salmonella enterica as consisting subspecies I, II, IIIa, IIIb, IV and VI, and V or enterica, salamae, arizonae, diarizonae, houtenae and indica respectively, while Salmonella bongori is subspecies V [35, 54]. The subspecies are represented by roman numerals or name [54].

Names are used for serotypes in subspecies I by the CDC, while antigenic formulas are used for serotypes that are not named within subspecies II, IIIa, IIIb, IV and VI, and V [54]. The names of serotypes in subspecies I are usually the geographical names of where the serovar was first isolated (Table 3). The first letter is usually capitalized and the word is not italicized, S. enterica subsp enterica serovar Zaria or S. enterica subsp enterica serovar London are possible examples. The names could also be summarily written as Salmonella Zaria or Salmonella London [8, 27, 66].

Serovars from subspecies II, IIIa, IIIb, IV, VI and V that have been given names before 1966 retain their names; e.g. Salmonella Marina (IV, 48: g, Z51:-), while all others are identified with antigenic formula. The formula are designated as follows; subspecies identification I-VI, the designated number of the somatic ‘O’ antigen, colon, flagella ‘H’
antigen phase I, colon, and flagella ‘H’ antigen phase II (if present). Example is *Salmonella* serotype IV 45: g, Z51: - implies *Salmonella* Houtenae (subspecies IV), ‘O’ somatic antigen 45, ‘H’ flagella antigen phase I g and Z51, while flagella ‘H’ antigen phase II is absent [24].

Table 1: Kauffmann-White scheme’s *Salmonella* species, subspecies, serotypes and their usual habitats [27].

<table>
<thead>
<tr>
<th><em>Salmonella</em> species and subspecies</th>
<th>No. of serotypes within subspecies</th>
<th>Usual habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S. enterica</em> subspecies <em>enterica</em> (I)</td>
<td>1,454</td>
<td>Warm-blooded animals</td>
</tr>
<tr>
<td><em>S. enterica</em> subspecies <em>salamae</em> (II)</td>
<td>489</td>
<td>Environment /Cold-blooded animals</td>
</tr>
<tr>
<td><em>S. enterica</em> subspecies <em>arizonae</em> (IIIa)</td>
<td>94</td>
<td>Environment /Cold-blooded animals</td>
</tr>
<tr>
<td><em>S. enterica</em> subspecies <em>diarizonae</em> (IIIb)</td>
<td>324</td>
<td>Environment /Cold-blooded animals</td>
</tr>
<tr>
<td><em>S. enterica</em> subspecies <em>houtenae</em> (IV)</td>
<td>70</td>
<td>Environment /Cold-blooded animals</td>
</tr>
<tr>
<td><em>S. enterica</em> subspecies <em>indica</em> (VI)</td>
<td>12</td>
<td>Environment /Cold-blooded animals</td>
</tr>
<tr>
<td><em>S. bongori</em> (V)</td>
<td>20</td>
<td>Environment /Cold-blooded animals</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,463</strong></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: The nomenclature of *Salmonella* used at the CDC [66]

<table>
<thead>
<tr>
<th>Position of taxonomy</th>
<th>Nomenclature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genus (in italics)</td>
<td><em>Salmonella</em></td>
</tr>
<tr>
<td>Species (in italics)</td>
<td><em>enterica</em> (subspecies I, II, IIIa, IIIb, IV and VI)</td>
</tr>
<tr>
<td></td>
<td><em>bongori</em> (formerly subspecies V)</td>
</tr>
<tr>
<td>Serotype (Word not italicized, first letter capitalized)</td>
<td>The name of a serotype should be preceded by the word “serotype” or “ser.”, the first time it’s mentioned in a text</td>
</tr>
<tr>
<td></td>
<td>Subspecies I serotypes are named, those in subspecies II to IV, VI and <em>S. bongori</em> are designated by antigenic formulae</td>
</tr>
<tr>
<td></td>
<td>Subspecies II, IV, VI and <em>S. bongori</em> members retain their names if named before 1966</td>
</tr>
</tbody>
</table>

CDC - Centers for Disease Control and Prevention
Table 3: The nomenclature of Salmonella in recent literature reflecting location of isolation [66].

<table>
<thead>
<tr>
<th>Complete name</th>
<th>CDC designation</th>
<th>Older designation</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S. enterica</em> subsp. <em>enterica</em> ser. <em>Typhi</em></td>
<td><em>Salmonella</em> ser. Typhi</td>
<td><em>Salmonella typhi</em></td>
</tr>
<tr>
<td><em>S. enterica</em> subsp. <em>enterica</em> ser. <em>Typhimurium</em></td>
<td><em>S.</em> ser. <em>Typhimurium</em></td>
<td><em>Salmonella typhimurium</em></td>
</tr>
<tr>
<td><em>S. enterica</em> subsp. <em>salamae</em> ser. <em>Greenside</em></td>
<td><em>S. ser. Greenside</em></td>
<td><em>S. II 50:z:e,n,x, S. greenside</em></td>
</tr>
<tr>
<td><em>S. enterica</em> subsp. <em>arizonae</em> ser. 18:z,4,23:-</td>
<td><em>S. IIIa 18:z4,z23:-</em></td>
<td><em>Arizona hinshawii”</em> ser. 7a,7b:1,2,5:-</td>
</tr>
<tr>
<td><em>S. enterica</em> subsp. <em>houtenae</em> ser. <em>Marina</em></td>
<td><em>S. ser. Marina</em></td>
<td><em>S. IV 48:g,z51:-, S. marina</em></td>
</tr>
<tr>
<td><em>S. bongori</em> ser. <em>Brookfield</em></td>
<td><em>S. ser. Brookfield</em></td>
<td><em>S. V 66:z41:-, S. brookfield</em></td>
</tr>
<tr>
<td><em>S. enterica</em> subsp. <em>indica</em> ser. <em>Srinagar</em></td>
<td><em>S. ser. Srinagar</em></td>
<td><em>S. VI 11:b:e,n,x, S. srinagar</em></td>
</tr>
</tbody>
</table>

Figure 1: (A) Somatic O and Flagella H antigen of *S. Typhimurium*. (B) Structure of the flagellar attached to the basal body of the organism. (C) Outermost portion of lipopolysaccharide (LPS) of the organism cell wall.
A. Uninoculated BGA plate

BGA plate inoculated with *Salmonella* spp.
The colonies are red because the bacterium does not ferment lactose or sucrose

B. Uninoculated XLD plate

XLD plate inoculated with *Salmonella* spp.
The colonies are red with black center. Serovars Typhi and Paratyphi A may produce only clear colonies without H2S. *E. coli* produce yellow colonies.

C. Uninoculated BSA plates

*Salmonella* ser Typhi colonies on Bismuth sulphite (BS) agar

Figure 2: *Salmonella* growth on Brilliant Green Agar (BGA) (A), Xylose Lysine Deoxycholate (XLD) (B) and Bismuth sulfite Agar (BSA) (C) plates (WHO, 2010).
Occurrence of salmonellosis

Salmonellosis incidence is defined as the identification of Salmonella from human, animal/group of animal-products or surroundings that can be specifically related to identifiable human, animal or animal’s feed. The health authorities are to be notified in cases of Salmonella identification [67].

Salmonella causes different disease syndromes ranging from enteritis, septicaemia and abortion, while meningitis is a rare complication that is diagnosed in less than 1% of clinical salmonellosis [68, 69]. Most of the diseases caused by Salmonella show little specificity for their host specie [70, 71]. In many countries of the world, one of the most significant public health challenges is salmonellosis [17, 72, 73]. Outbreaks have been reported from eggs and poultry in southern Thailand [17], meat and beef in Europe and USA [23, 74], raw milk, pork meat, chocolate in many parts of Africa and Europe [74 - 76]. Outbreaks have also been reported from insects and wildlife in Africa, USA and Europe [75, 77, 78].

The incidence and severity of the disease is reported to be considerably on the increase [23, 79 - 81]. Over 192,703 salmonellosis cases in humans were recorded in the European Union alone in 2004 [82]. In 1997, the most reported serovar associated with food contamination is S. Typhi, while the third most common serovar associated with food borne salmonellosis outbreak is Salmonella Newport [83]. Salmonella Seftenberg 775W in liquid culture media is notably heat-resistant [84, 85]. Higher thermal resistance is usually observed in Salmonella serovars that survived dryness and desiccation [86]. Although Salmonella has not been reported to grow in substrates whose water content is \( a_w < 0.93 \), the organisms can however, stay alive for many months and grow during favourable conditions [85, 87]. Clinical isolation rates of known foodborne serotypes such as S. Enteritidis, are declining, while clinical isolation rates of serotypes whose transmission routes are not well defined such as S. Javiana and S. Muenchen are increasing [88]. Moreover, animal host species of these serotypes are not defined and may include animals that are not generally consumed by humans [89].

Between 55% and 95% of human salmonellosis cases are contracted through ingestion of food while about 9% are caused through direct contact with animals [90 - 93], salmonellosis that occur due to contact with pets are about 3% [94]. Veterinarians and physicians reported that after toxoplasmosis, the second most important zoonosis is salmonellosis [95]. The disease is potentially of risk to immunocompromised individuals, the elderly and children [96].

Non-typhoidal salmonellosis (NTS)

All over the world, the most prominent cause of acute bacterial gastroenteritis is non-typhoidal salmonellosis (NTS). It is estimated that in the United States, alone 1.4 million people fall ill annually due to salmonellosis [44]. Worldwide, NTS causes three million deaths and 1.3 billion gastroenteritis cases [20]. The United Kingdom in 2013 reported more than 7,500 cases of human salmonellosis [93]. Despite the self-limiting nature of the acute enteritis caused by Salmonella spp., complications may occur in infected humans due to severe systemic sequellae. The serovars involved in the infection and other host specific factors influence the severity of the infection [97, 98].

Typhoidal salmonellosis

Typhoidal salmonellosis is caused by Salmonella species. Salmonella Typhi is the aetiological agent of typhoid fever. Salmonella Paratyphi A, B and C are the causes of syndromes similar to typhoid fever. These organisms are usually transmitted directly from human-to-human [99 - 102]. Typhoid fever has been declared as endemic in tropical and sub-tropical countries [103]. Worldwide, there are estimated annual incidences of 540 per 100,000 or about 16 million including 600,000 deaths [20, 100, 104-106].

The symptoms presented by infected individuals include fever, headache, nausea, abdominal cramps, vomiting and diarrhoea. In severe or chronic cases, other symptoms like
arthritides may be experienced between 3 - 4 weeks after the onset of symptoms [107, 108].

**Conclusion**

The knowledge of the general characteristics of bacteria in the *Enterobacteriaceae* family and those specific to the genus *Salmonella* is essential for proper differentiation and identification of the organism from human and animal specimens. The division of members of the genus to only two general species compared to many other bacteria in and outside the family is a noteworthy peculiarity. Progressive research on the characteristics of *Salmonella* on the publication of their output contributed to the body of knowledge about the organism and identification of new isolates.

The history of *Salmonella* indicated isolation of the organism from humans and different types of animals since the 19th century thereby underscoring the ubiquitousness and multispecies-host nature of the organism and the diseases it causes.

Typhoidal and non-typhoidal salmonellosis is a notifiable disease with wide host range. The increasing severity and incidence of the disease all over the world especially Africa is however, of public health concern because of the incidence is mostly food associated. Food, especially those of animal origin and direct animal contact are responsible for 55-95% of human salmonellosis and are contributing to the increasing rate of the diseases in human and animals.

**Conflict of interest**

Authors declare, there is no conflict of interest.

**References**


الملخص العربي
مراجعة لخصائص السالمونيلا، التصنيف والتمييز مع إشارة خاصة إلى السالمونيلا غير التيفية والتيفية

ينتمي جنس السالمونيلا Yلى عائلة البكتيريا المعوية. كما لديها خصائص نمطية/وراثية وتاريخ مثير للاهتمام.

تتم السالمونيلا بتسميات غريبة مقارنة بالبكتيريا الأخرى داخل وخارج العائلة. تعد البكتيريا هي المسبب لداء السلمونيلات التيفيودية (TS) والسالمونيلا غير التيفيودية (NTS)، والتي تظهر تباينات مختلفة في الإنسان والحيوان بالإضافة إلى كونها ذات أهمية للصحة العامة في جميع أنحاء العالم. استعرضت هذه الدراسة خصائص السالمونيلا وتصنيفها وتسليحها وطبعاتها بالإضافة إلى نظرة عامة على TS و NTS. اعتمدت هذه الدراسة على البيانات والمعلومات الأساسية المنشورة في المجلات والكتب والمقالات. أظهرت البيانات المجمعة للدراسة أن السالمونيلا يبلغ حجمها 2-3 × 0.4-0.6 ميكرومتر، سالبة الجرام، غير قادرة على التحوصل، غير منتجة لكل من أوكسيديز، إندول ووربيز، سالبة لسكرات الألكوز والسكروز، لاوهاوية اختيارية وقادر على الحركة. يختلف نوع السالمونيلا الموجود في TS على موتات E. coli و Shigella على الرغم من أن كلا النوعين مرتبطان ارتباطًا وثيقًا بـ 16S rDNA. أنواع السالمونيلا وأسماء أجناسها تكتب مائلة في الإنجليزية، لكن غير مكتوب بخط مائل. تعد السالمونيلا هي المسبب لـ TS و NTS في الإنسان والحيوان حيث تظهر التهاب الأمعاء وتسمم الدم والإ佘اء والالتهاب السحيبي. تتضمن تقلبات داء السلمونيلات من الأغذية والمنتجات الغذائية أو حيوانات التماس وخلايا الدم الحر. يعد المرض من بين تحديات الصحة العامة الأكثر شيوعًا في أجزاء مختلفة من العالم مع زيادة حدوث العديد من الأمراض المصلية. وقد تم تطبيق الضوء على دور الميكروب باعتباره من المسببات الرئيسية للأمراض المنقولة عن طريق الأغذية وتسمم الدم مما يؤدي إلى المرض والوفيات في جميع أنحاء العالم. يجب إجراء بحث مستمر حول السالمونيلا والأمراض الناتجة عنها للمساعدة في تكوين معرفة وتحسين الاستراتيجيات الوقائية/العلاجية في المرض في نهاية المطاف.