

cat and camels, respectively, act as amplifier hosts (40, 41).

Coronaviruses genomes and subgenomes encode six ORFs (31). The majority of the 5' end is occupied by ORF1a/b, which produces 16 nsps. The two polyproteins, pp1a and pp1ab, are initially produced from ORF1a/b by a −1 frameshift between ORF1a and ORF1b (32). The virus-encoded proteases cleave polyproteins into individual nsps (main protease [Mpro], chymotrypsin-like protease [3CLpro], and papain-like proteases [PLPs]) (42). SARS-CoV-2 also encodes these nsps, and their functions have been elucidated recently (31). Remarkably, a difference between SARS-CoV-2 and other CoVs is the identification of a novel short putative protein within the ORF3 band, a secreted protein with an alpha helix and beta-sheet with six strands encoded by ORF8 (31).

Coronaviruses encode four major structural proteins, namely, spike (S), membrane (M), envelope (E), and nucleocapsid (N), which are described in detail below.

S Glycoprotein

Coronavirus S protein is a large, multifunctional class I viral transmembrane protein. The size of this