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The acceptability of '*Star Yellow*,' a Cameroonian functional food that could curb the spread of the COVID-19 via feces

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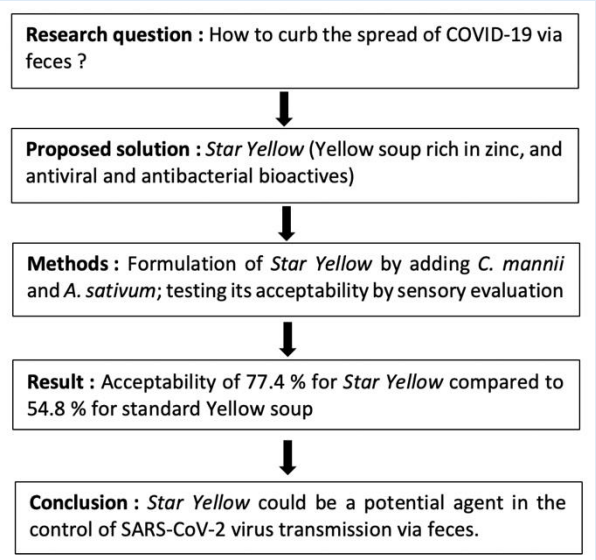
ABSTRACT

Background: COVID-19 is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Despite the World Health Organization's publication of different measures to curb the spread of COVID-19, new cases are reported daily. These protective control measures put in place assumed that transmission of COVID-19 was mediated essentially through droplets released from the nasal and respiratory secretions of infected persons. Recent scientific evidence however puts forward the occurrence and shedding of active COVID-19 virus in stools of infected persons. The present study tested the acceptability of an improved version of the 'Yellow soup' which contains ingredients/spices with known antibacterial/antiviral properties.



Methods: *Star Yellow* was made by using a palm oil/limestone base to which was added spices /ingredients rich in zinc and known for their antiviral/antibacterial activity. Sensory evaluation of the resulting mixture was done by a taste panel comprising habitual eaters of 'Yellow soup' using a hedonic scale of 1 to 5.

Results and Conclusion: Sensory assessment of Star Yellow showed a mean acceptability of 77.4% compared to 54.8% obtained for the commercial Yellow Soup served in restaurants. This indicates the acceptable taste of *Star Yellow* and opens up potential new avenues of research in the control of SARS-CoV-2 virus transmission via feces.

Keywords: Yellow soup, COVID-19, feces, gastrointestinal tract, zinc, RNA replication.

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The outbreak began in Wuhan, China in December 2019 and spread rapidly, with cases now confirmed in over 210 countries and territories [1]. The first case in Cameroon was reported on 6 March 2020 by the Ministry of Health. To date, there have been 2,408,352 confirmed cases worldwide, with more than 1000 in Cameroon, and rising. Presently there is no treatment for COVID-19, with disease management strategies only geared to treating the accompanying symptoms and limiting its spread. Despite the World Health Organization's publication of different measures to curb the spread of COVID-19, as well as specific measures put in place by the Cameroon government, new cases are reported daily. These protective control measures put in place assumed that transmission of COVID-19 was mediated essentially through droplets released from the nasal and respiratory secretions of infected persons. Recent important scientific evidence however puts forward the occurrence and shedding of active COVID-19 virus in stools of infected persons [2]. This raises the need for the control of the possible spread of this virus through feces, especially in areas with poor hygienic conditions. With SARS-CoV-2 being an RNA virus, its efficient control can only be totally achieved by stopping RNA replication. One way this could be achieved is by the use of a functional food with antiviral/anti RNA replicating activity to specifically target those in the digestive tract.

The Cameroonian cuisine is extremely rich in variety and content, with many traditional dishes known for their functional potential. These dishes like all functional foods therefore do not only provide the body with key nutrients, but also serve a protective and/or curative role. One such dish is 'yellow soup' which is widely eaten in the grass field regions of the country, and is now an exotic dish in the major cities (Yaounde and Douala) where persons go to specific restaurants just for this delicacy, and is well sought out for at receptions. Therefore, using the main ingredients of a locally known yellow soup, we added spices with known antiviral and antioxidant activity and came up with "STAR YELLOW".

METHODOLOGY

Preparation of Star Yellow: Star Yellow was prepared heating palm oil (500 ml) in a sauce pan to a consistent liquid. Limestone (30 grams) was added and stirred until it was completely dissolved. The mixture was transferred into a food blender (Moulinex LM1AOD19 model) and 2000 ml of beef stock added. The other ingredients in the quantities shown on Table 1 were added to the mixing bowl and blended at top speed intermittently for 3 minutes.

Table 1. Composition of Star Yellow with references of peer review articles on their functionality

Ingredient	Quantity	Reference to functionality
Palm oil (L)	0.5	Essential for saponification/ breakdown of viral membrane
Water / beef stock (L)	2.0	Zinc source
Lime stone (g)	30	Essential for saponification / breakdown of viral membrane
Capsicum annum (g)	2.0	[3], [4]
Dichrostachys glomerata (g)	5.0	[5], [6], [7]
Tetrapleura tetraptera (g)	4.0	[8], [9]
Monodora myristica	3.1	[10]
Piper guineense (g)	3.4	[11]
Cucumeropsis mannii (g)	6.0	[12]
Allium sativum (g)	2.0	[13], [14]
Scorodoploeus zenkeri (g)	3.3	[15]
Xylopia parviflora (g)	2.4	[16]
Afrostyrax lepidophyllus bark (g)	18.0	[17]

Table 2. Taste panel used to determine acceptability of yellow soup formulation (Star Yellow).

	1 	2	3	4	5 
How does Star Yellow look?					
How does Star Yellow taste?					
How does Star Yellow feel in the mouth?					
How does Star Yellow smell?					
How would you rate Star Yellow overall?					
How does Star Yellow compare with yellow soup served in restaurants?					

The evaluation of each characteristic was done on a scale of 1 to 5 (1 = not good for consumption; 2 = poor; 3 = not sure; 4 = good; 5 = excellent).

This yielded a modified soup referred to as 'Star Yellow' (*Etoile Jaune* in French) which was subjected to a taste panel.

Sensory Analysis: Twenty-six panelists (13 females and 13 males) aged between 22 and 45 years and who knew and regularly ate the standard preparation of yellow soup were used. Commercial Yellow soup bought from 3 different restaurants in Yaoundé, Cameroon were used as the reference. Each panelist rated the yellow soup based on the six criteria outlined in Table 2 above. The rating ranged from 1 to 5, with a score of 1 representing the soup not being good for consumption to a score of 5 representing excellent. Data was analyzed using Prism statistical software (Graph Pad Inc.). Comparisons of each parameter was done between Star Yellow and the commercial Yellow Soup using ANOVA with Turkey's post-test. Differences between groups were considered significant for any p-value < 0.05.

RESULTS

Besides the main ingredients used in the preparation of yellow soup, (palm oil and lime stone) and beef (rich in zinc - 4.8mg per100g), various spices with known antiviral and antioxidant activity are usually part of the standard formulation. To increase the functionality of the yellow soup, ground melon seeds (egusi) known for their high zinc content (8mg per 100 grams) as well as garlic *(Allium sativum*) known for its anti-bacterial properties were added. The content of *Dichrostachys glomerata* was increased from that used in the standard preparation to facilitate zinc transport. The present study modified the typical composition of the yellow soup (Star Yellow) with the addition of *C. mannii* and *A. sativum* as well as increasing the amount of *D. glomerata*. Results of the sensory test (Table 3) showed a > 70% acceptance of Star Yellow, by the Panelists who previously consumed Yellow soup as a staple. This rating was significantly ($p<0.5$) higher than the rating given for Yellow soup bought from 3 different restaurants in Yaounde. Introduction of Star Yellow into the staple diets of persons who had not previously eaten Yellow soup is therefore possible.

DISCUSSION

Consumption of 'Star Yellow delivers its functional components (Table 1) directly into the gastrointestinal tract which could be a reservoir for live virus in COVID-19 patients [18]. The functional components in 'Star Yellow' have been shown *in vitro* and *in vivo* tests to possess anti-viral and antioxidant properties. *C. mannii* and beef stock provide zinc

Table 3. Sensory analyses of Yellow Soup and Star Yellow

Sample	Appearance	Taste	Feel	Smell	Overall	Comparison
Yellow Soup	3.83 ± 0.72^{a}	3.35 ± 0.71^{ab}	3.22 ± 0.85^{ab}	3.83 ± 0.98^{a}	3.26 ± 0.86^{ab}	3.39 ± 0.72^{a}
Star Yellow	3.47 ± 1.20^{ab}	3.61 ± 0.94^{c}	3.70 ± 0.88^{b}	3.18 ± 1.14^{ab}	3.87 ± 0.81^{b}	3.65 ± 0.88^{a}
Restaurant Yellow soup	2.68 ± 1.06^{b}	2.58 ± 0.96^{a}	2.63 ± 0.89^{a}	2.74 ± 1.05^{b}	2.74 ± 1.05^{a}	2.53 ± 0.84^{b}

Values are means ± SD. The values assigned different letters within the same column are statistically different at $p<0.05$.

which is a potent inhibitor to RNA replication in viruses [19,20]. The action of zinc however and access to the viral RNA can only be achieved if there is effective transport through the lipid-protein based viral envelope which shields the RNA. Two mechanisms could therefore be active against the propagation of the virus – deformation of the protein embedded in the envelope thereby making adhesion to host cells impossible or disintegration of the lipids that form the physical barrier. The combination of palm oil and limestone represents a reaction of a metallic alkali (base) with fat, generally referred to as saponification. The resulting product has the potential to break down the viral envelope exposing its RNA to zinc, which inhibits replication by blocking a key viral enzyme utilized for replication in host cells, RNA polymerase [19]. On the other hand, the chemical structure of *D. glomerata* has aromatic rings similar to that in the chloroquine molecule with the benzothiophine derivative pyrithione possibly forming zinc ionophores which alter the permeability of the viral envelope, thus enhancing zinc transport [21]. With these two possible mechanisms in place, Star Yellow will possibly breakdown the envelop of the SARS-CoV-2 present in the gastrointestinal tract of infected persons**,** exposing it to the zinc present. The feces as well as the resulting fecal bioaerosols will therefore contain only inactive viral particles, thereby stopping transmission by feces. This is of even greater significance since there is evidence of viable SARS-CoV-2 on plastic and stainless steel after 72 hours [22] as well in adult patients whose fecal samples remained positive for SARS-CoV-2, 13 days after their pharyngeal samples tested negative [23]. The challenge could be even greater for pediatric patients who may not show clear clinical signs or chest X-ray findings consistent with pneumonia as seen in adult patients but are positive for the virus as determined by rectal swabs [24]. There is also emerging evidence of patients (20 to 50 years old) testing positive for SARS-CoV-2 shortly after undergoing treatment and recovery. This could be due to reinfection from the GI tract reservoir of the virus, raising the need for treatment protocols to include action against this reservoir as could be provided by 'Star Yellow', effectively controlling the spread of SARS-COV-2 via feces until such a time that a vaccine is available.

CONCLUSIONS AND RECOMMENDATIONS

Star Yellow, an enriched version of the conventional and widely consumed Cameroonian 'Yellow soup' had as base a mixture of palm oil and limestone, to which was added various spices of known antiviral, antibacterial and anticoagulant activities. This combination gives *Star Yellow* its functional property. Participants in the present study found the taste of *Star Yellow* to be better than that of the conventional Yellow Soup, making it immediately available for addition to the wide variety of Cameroonian dishes. The inclusion of Star Yellow in our routine diets can therefore be encouraged since it gets into direct contact with viral particles as well as other microorganisms to provide beneficial effects. One such effect could be the deactivation of viral particles thereby preventing the transmission of active viral particles via feces.

Competing Interests: GT is an employee of J & A Oben Foundation who provided funding for the project.

Author's Contributions: JO, JB, IT and RL contributed to the conception and design of the study, analysis, interpretation of the data and drafted the manuscript for important intellectual content. JO and GT were involved in the collection of the data. All authors

approved the version of the manuscript to be submitted.

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