

Communication

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Communication

From the Culinary Art by the Microbiology Science: “The Similarities”

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Abstract: The microorganisms living around and inside the human host in an extraordinary way for their morphologies often remind, microscopically we find every day foodstuffs that in our tables. **Background:** Many food products “are similar” to bacteria, a sort of “convergent evolution” between the microscopic and the macroscopic. Here below, we present some “similarities” between bacteria and food suggesting “New Recipes” of the Abruzzo Region folk tradition in Central Italy, which handed down from father to son constituted the history of our land. We believe that the history of a people is the true identity of man and passion for their roots should never be circumvented. Passion that binds us to our traditions, the same that binds us to our work, microbiology, making it natural for us during lunch hour, in the laboratory, to speak of the particular similarities of bacteria found with the foods we consume daily. **Methods:** We compared to same macroscopic food products to the following bacteria: *Helicobacter pylori*, *H. heilmannii*, *Neisseria meningitidis*, *Staphylococcus aureus*, *Leptospira interrogans*, and *Pseudomonas aeruginosa*. **Results:** In particular, we identified for each microorganism “similarities” with food and proposed New Recipes inspired for their “assonance” to microbial morphology and behavior and hence, suggest the following: “the Conversion”, “the Unidentical Fusilli Twins”, “the Dangerous Peaches”, “the Greek Grape Cluster Cake”, “the Black Cuttlefish Spirals sauce” and “the Biofilm Green Zucchini”. **Conclusions:** Therefore, arriving at a “special” approach that wants to link the microscopic and macroscopic worlds underlining that each shape is not casual and that everything is connected.

Keywords: microbiology; bacteria; culinary art; recipes

1. Introduction

The extraordinary way of microorganisms lives around and inside the human host and their morphologies often remind us, microscopically, of the foodstuffs we find everyday on our tables. In recent years' consciousness that bacteria represent a part of the human host has been taken [1]. This strong association makes man and microorganisms very similar to each other; a similarity that makes a common ancestor come to mind. This concept, as we, a group of microbiologists and the authors of the text, has surprisingly led us to the fact that many microorganisms have “similarities” with the food that makes up our daily diet. The leavening of bread, wine and beer fermentation with *Saccharomyces cerevisiae* date back to ancient Egyptians [2], making us understand how, philosophically, bacteria have always been a part of human life.

As for “Food and History” [3], throughout time, there have been many confronted researchers, nutritionists and culinary experts that found correlations between food and daily life. Therefore, Culinary Arts was structured using a historical-scientific path enriching knowledge and human needs exactly as a real science [4,5]. Culinary Arts has many similarities with microbiology as precision in the execution of recipes that could be compared to laboratory experiments, study, passion and finally the objectives to be achieved: for microbiologists the scientific research, for the

chef the mise en place for lunch. Additionally, many culture media for microorganisms, are composed of ingredients that we usually find on our tables such as olive oil, which has been assigned as one of the inductors of lipase production, eggs, sugar etc. showing a strong correlation between food and microbiology [6].

Just as research is world heritage in time, Culinary Art holds the wisdom and traditions of peoples; moreover, the preparation of new recipes, the need of experiments and tests in order to achieve the expected results are the same as in scientific studies.

Many food products macroscopically show "similarities" to the shape of bacteria. A kind of "convergent evolution" between the microscopic and the macroscopic world. This new perspective, the assonance in seeing our world with that of the "tiny one" apparently far from each other, but in reality are not as can be seen in the work proposed to present some "Similarities" between bacteria and food suggesting "New Recipes". These Recipes come from the tradition and history of our Abruzzo Region, which handed down from father to son constituted the history of our land [4]. We feel that the history of a people is the true identity of man and passion for their roots should never be circumvented.

The passion that binds us to our traditions, is the same passion for our work, microbiology, and in the laboratory, during lunch we speak often of the particular similarities of bacteria found with the foods that we consume daily.

The bacteria examined are: *Helicobacter pylori*, *H. heilmannii*, *Neisseria meningitidis*, *Leptospira interrogans*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*. For each microorganism tested identified were "similarities" with food and new recipes inspired by "assonance" of morphologies proposed. Next came "the Conversion" (*H. pylori*), "the Unidentical Fusilli Twins" (*H. heilmannii*), "the Dangerous Peaches" (*Neisseria meningitidis*), "the Spirals in Cuttlefish Black sauce" (*Leptospira interrogans*) "the Greek Grape Cluster Cake" (*Staphylococcus aureus*) and "the Biofilm Green Zucchini" (*Pseudomonas aeruginosa*).

In this study of similarity between the microbiology and the culinary arts we wanted to focus the scientific interest in these great sciences of which we are passionate.

2. Materials and Methods

2.1. Background of the Traditional Cuisine and Wines in Abruzzo

Abruzzo cuisine has had benefits for genuine local products and ingredients, from the Adriatic on one side and the Gran Sasso on the other.

Origin were poor ingredients. The economy of the region, for centuries, has allowed barely survive; agriculture and pastoralism gave no comfort. A socially modest area both economically and culturally, so much so that in the famous treatises of antiquity of Italian cuisine, local gastronomy, does not appear; absence resulting from the fact that the cuisine of this region was unknown beyond the borders. Only in the last century things have changed and the kitchen and the tradition of Abruzzo have crossed all boundaries. Very popular among the products offered by the region are those of sheep farming, especially the cheese: scamorza, caciocavallo, pecorino, offer perhaps the most intense flavors that are found in recipes, especially in the inland areas and mountains. The coast, it makes known the taste of the sea: blue fish and shellfish. Going into the interior of the region you can appreciate the beauty of the landscape and architecture, the dignified nobility, the ancient customs and civilization of a modest society where the cuisine and wines become important moments: every place has its own specialties, its flavors handed down for centuries, preserving their authenticity defeating the industrial advent.

2.2. Abruzzo Wines

Montepulciano red wine and Trebbiano white wine, are the wines from Abruzzo who are gradually become prominent worldwide since after the 60 were classified as "DOC". The Cerasuolo wine is a little cherry red. Pecorino, a white wine made from an ancient vine grower who have revived in recent years, recently became one of the most incisive successes in the world of the Abruzzi viticulture.

2.3. Raw Materials and Sample Preparation

For this study, we used local produce zero kilometer. The peas, cuttlefish and all the ingredients were purchased in Abruzzo local markets of the provinces of Chieti and Pescara on the same day of execution of the recipes/experiment. The paste used in this study came from one of the most important Abruzzo pastaie Companies, De Cecco of Fara San Martino, famous worldwide for its quality and its particular types. Since 1886, the company De Cecco has pursued without compromising the tradition of pasta making it possible to bring on tables all over the world the authentic pleasure of Italian cuisine.

2.4. Equipment

To prepare recipes/experiments were used in pottery and copper utensils, while respecting the traditions and executed following the transcripts of an old cookbook, respecting the ingredients, high quality and times.

2.5. Microorganisms, New Recipes, Ingredients and Cooking Conditions

The first association carried out was with *H. pylori*, the causative agent of chronic gastritis and peptic ulcer active, described as a risk factor for gastric cancer [7]. *Helicobacter pylori* (Figure 1 top A, B) is a microorganism that responds to environmental stress conditions through morphological changes from rod-to coccoid forms [8–10]. The similarity is that we observed with Stortini and Peas (Figure 1 down a, b). As well as *H. pylori* changes in their morphological also been forming biofilm, so Stortini and Peas are mixed in an excellent dish, example of freshness and simplicity. The Recipe for "the Conversion" was shows in Table 1. Stortini and peas reminds farmers flavors, but simple gifts of a civilization, which in Spring, discovered anew the taste of being together around a table with the sweet taste of freshly picked peas and enrichment of a simple but passionate sauce. As well as *H. pylori* in its morphological were also aggregates forming biofilm, so Stortini and peas are mixed in an excellent dish, example of freshness and simplicity.

The second association was done with *H. heilmannii* Gram negative microorganism that colonizes the gastric mucosa of domestic animals, and in particular cats. Since the discovery of *H. pylori* as a human pathogen many studies have evaluated the link between the infection of *Helicobacter* spp. and gastric disease in animals. Figure 1 (C, top) shows an image at the transmission electron microscope of a typical helical bacterium coming from cat gastric biopsy [11,12]. The similarity we have observed is a type of pasta, short Fusilli (Figure 1 c, down). The Recipe for "the Unidentical Fusilli Twins".was shows in Table 1. The recipe that we show, that blends the flavors of the South, certainly please everyone.

Let us now discuss of *N. meningitides* (Figure 1 D, top) Gram-negative bacterium in the coffee bean, the etiologic agent of bacterial meningitis [13]. *Neisseria meningitidis* is an important cause of morbidity and mortality worldwide. The similarity that we have observed, in addition to the coffee bean, is with it sweet peach, typically Abruzzese delicious biscuits (Figure 1 d, down. "the Dangerous Peaches", recipe).

The Recipe for "the Dangerous Peaches ". was shows in Table 1. The famous peaches with alchermes have a sweet Abruzzo typical that brings us back to the ancient times of festivity and communions and marriages where, usually the landlady, saying the guests handing the tray: favorite!

Let us now consider *S. aureus*, Gram positive cocco, spherical, asporogenous and aerobic optional [14]. The bacterium is named after the ancient greek: Staphyle = cluster, coccus = sphere, resembling a bunch of grapes. *Staphylococcus aureus* (Figure 1 E, top) is capable of forming biofilms on biotic and abiotic surfaces with dynamic processes that involve different mechanisms. Just the mature biofilms of *S. aureus* can be compared to the cluster of grapes (Figure 1 e, down) with an outstanding likeness. From this the association with a sweet "the Greek Grape Cluster Cake" to evoke characteristic pairs, food/bacteria in this case grapes and *S. aureus*.

The Recipe for "the Greek Grape Cluster Cake": this is a delicious custard pie topped with Grapes was shows in Table 1.

And still *Leptospira interrogans* (Figure 1 F, top) Gram-negative microorganism, aerobic obligated, and mobile, etiologic agent of leptospirosis, a disease transmitted from animals to humans [15,16]. The extraordinary similarity we have observed is a type of pasta, the long Fusilli (Figure 1 f, down).

The Recipe for "the Spirals in Black Cuttlefish" was shown in Table 1.

Finally, we analyzed the similarity with *P. aeruginosa* (Figure 1 G, top), bacillus Gram-negative, flagellated, mobile non-fermenting [17,18] with zucchini (Figure 1 g, down). The recipe "the Biofilm Green Zucchini" is an ancient Jewish Ghetto of Rome in preparation for the world-famous, but that is renowned throughout Italy and in the world.

The Recipe for "the Biofilm green Zucchini" was shown in Table 1.

2.6. Scanning Electron Microscopy

For scanning electron microscopy (SEM) observation and image analysis of *H. pylori*, the samples were pre-fixed in a solution of 2.5% (vol/vol) glutaraldehyde with 0.1 M cacodylate buffer at pH 7.2 for 1h and then washed with cacodylate buffer solution. After washing with phosphate buffered saline (PBS) (Oxoid), the samples were post-fixed in 2% (w/v) osmium tetroxide and dehydrated in a series of graded ethanol in water solutions ranging from 50% to 100%. All the samples were sputter-coated (Emitech K 550) with gold. SEM examination (LEO 435 Vp) was performed using secondary electrons (SE1) with a current probe varying from 49 to 200 pA at 20.00_25.00 keV. The digitized images were stored in.tif format with N_M_1024_768 pixels per 8 bits. Each cell, represented by a pixel in the grid, was assigned a value of between 0 and 255 (0_black;255_white) [8].

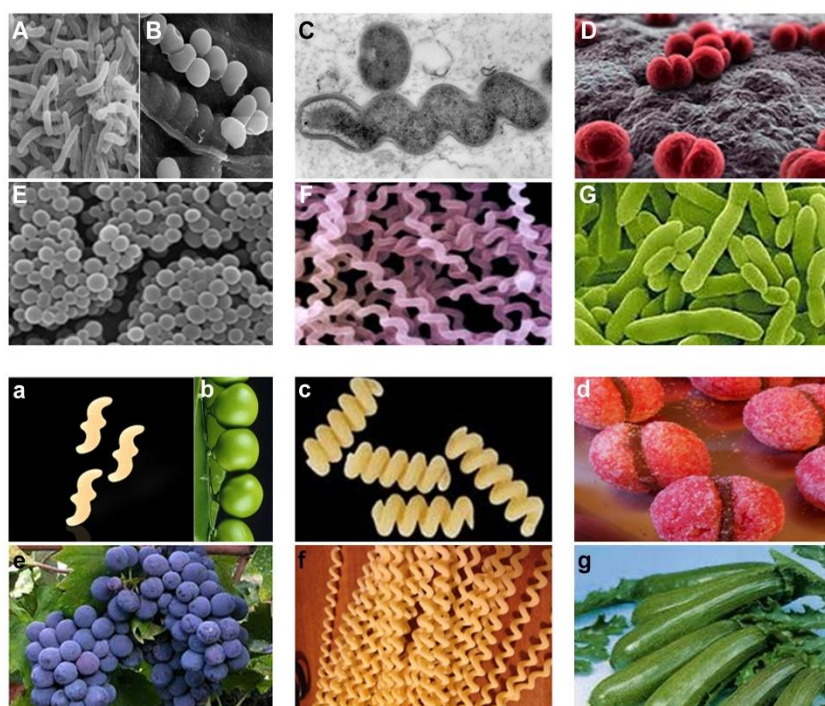


Figure. 1

Figure 1. Bacteria (top panel) and food (down panel) "similarities". Top: A, scanning electron micrograph of *Helicobacter pylori*, rod-shaped forms; B, scanning electron micrograph of *ex vivo* mature biofilm of *H. pylori* coccoid forms in gastric antrum (Cellini L et al. Scand J Gastroenterol. 2008, 43(2),178–185); C, transmission electron micrograph of *H. heilmannii* (Norris CR et al. J Clin Microbiol. 1999, 37(1),189–194); D, scanning electron micrograph of *Neisseria meningitidis* (<http://bioquell.asia/technology/microbiology/neisseria-meningitidis>); E, scanning electron micrograph of mature biofilm of *Staphylococcus aureus* (Nostro A et al. APMIS, 2012, DOI

10.1111/j.1600-0463.2012.02928.x); F, scanning electron micrograph of *Leptospira interrogans* (<http://www.visualsunlimited.com/image/I00005u9fY3.FU0h0>); G, scanning electron micrograph of *Pseudomonas aeruginosa* (<http://www.ca.globaltalentnews.com/sistema/aldia/232/La-UAB-lidera-un-proyecto-europeu-per-combatre-bacteris-patogens-multiresistents-als-antibiotics.html>). **Down:** a, Stortini (www.dececco.it); b, Peas; c, short Fusilli (www.dececco.it); d, Dangerous Peaches; e, grapes; f, long Fusilli; g, Zucchini. Scale Bars: 5µm.

Table 1.

Table 1

Recipes of foods prepared for the study.

Foods Ingredients	Quantity	Preparation	
The Conversion			
Fresh peas	300 g	Cut the onion very thinly and sauté 5 minutes, add the bacon and continue cooking for a few minutes and pour the peas with the tomato paste. Cover with plenty of vegetable broth and cook half an hour. Take a couple of ladles of peas and set aside. Add stortini in the same cooking pot of peas. When cooked pasta (at least 5 minutes), add salt. Serve hot. WINE recommended: Montepulciano d'Abruzzo Villa Gemma	
Red onion	1		
Bacon cut into cubes	70g		
Tomato paste	150 g		
Stortini	250 g		
Vegetable broth			
(carrot, onion, celery, tomato and other vegetables in cold water, bring to a boil for at least 1h)	1.5 L		
Salt, Black pepper			
EVO (extra virgin olive oil) ½	cup		
The Unidentical Fusilli Twins			
Short fusilli	400 g	Boil salted water. Pour the oil in a sauce pan, sizzle chilli and garlic for a few moments. Add the eggplants washed and diced small enough. Cook the eggplant over high heat for a few minutes, add the tomatoes, washed and cut in half. Season with salt and pepper and cook the eggplant for about 20 minutes, stirring from time; add olives and a ladle of hot water. Cook the fusilli until al dente and season with the sauce of eggplant and olives; sprinkle with the grated cheese and a few leaves of fresh basil and serve immediately. WINE recommended: Trigaio	
Fresh tomatoes	500 g		
EVO ¼	cup		
Clove of garlic	1		
Hot pepper			
Egg plants	100 g		
Black olives Taggiasche	100 g		
Grated cheese	100 g		
Salt, Fresh basil to taste			
White pepper to taste			
The Dangerous Peaches			
Soft butter	125 g	Work the softened butter with the sugar. Add the eggs, salt and flour previously sifted with baking powder. Mix and let rest half an hour in the fridge. Form balls of about 3 cm in diameter. Bake at 180 degrees for 10 minutes (do not overcook) and allow to cool. Once cold, roll in alcherones and sugar. Simmer milk, beat the egg yolks with the sugar in a saucepan. Add the milk to a boil and lemon peel. Put on medium heat and continue stirring until it thickens always. Remove from heat and add the melted chocolate. let cool. Take the balls and prepared to join two to form Peaches. WINE recommended: Moscato d'Asti	
Sugar	200 g		
Flour	500 g		
Eggs	2		
Teaspoon baking powder	1		
Alcherones			
Granulated sugar			
A pinch of salt			
(Ingredients for the custard)			
Milk			
300ml			
Flour	50 g	Wash the grapes, dry and cut each in half and remove the seeds. Heat oven to 180°C. Melt the butter. Place the flour and add the eggs with the sugar. Add the butter to the mixture and 1 tablespoon of milk. Mix until dough is compact. Store in refrigerator for 15 minutes. Roll out the dough evenly into a pie pan leaving by a border of 1 cm. With a fork, pierce holes throughout the middle and make the decorations on the edges. Meanwhile, prepare the custard: simmer the milk, beat the egg yolks with the sugar in a saucepan. Add the milk to a boil and lemon peel. Put on medium heat and continue stirring until it thickens always. Remove from heat and let cool. Take the prepared base and put in a uniformly spread the custard being careful not to over fill. Decorate with grapes previously prepared by arranging in a circle. Bake for 30 minutes. Allow to cool and serve. WINE recommended: Dama Cerasuolo di Montepulciano 2012.	
Lemon zest, Vanilla seeds			
Melted dark chocolate 100 g			
The Greek Grape Cluster Cake			
(Ingredients for the base)			
Flour	250 g		
Eggs	2		
Tablespoons sugar	2		
Butter	120 g		
Teaspoon of baking powder	1		
milk to soften the dough			
(Ingredients for the custard)			
Egg yolks	2		
Milk 300 ml			
Flour	50 g		
Lemon zest, Vanilla seed			
(Decoration)			
Black Grapes			

Foods	Ingredients	Quantity	Preparation
The Spirals in Black Cuttlefish			
Cuttlefish		2 (300-400 g each)	Clean the cuttlefish, retrieve the black liquid for preparation and aside; chop the cuttlefish. Boil water to cook pasta. Chop the shallot and sauté in a pan with olive oil and pepper. Wash the tomatoes and cut into 4 pieces and add them to the pan and add the squid after a while. Sprinkle with white wine and blend lightly. Wash and chop the parsley and add to the sauce. Drain the fusilli and pour into the pan, mixing well the pasta with the sauce. Serve and sprinkle with a little 'of ground black pepper. WINE recommended: WHITE PEPPER-Trebbiano d'Abruzzo DOC 100% <u>Organic</u> .
Long Fusilli		500 g	
Shallot		1	
Fresh cherry tomatoes		10	
(ripe plum or cherry type or Piccadilly)			
Parsley			
White wine		1 glass	
EVO		1 glass	
Salt to taste			
Black pepper to taste			
The Biofilm <u>green</u> Zucchini			
Zucchini		1 Kg	Wash zucchini and cut thin, the length; Prepare the mixture order of garlic, parsley and mint. Fry the zucchini with plenty EVO and drain on paper towels, add a pinch of salt and pepper, and allow to cool. Arrange the zucchini in alternating layers with the chopped garlic and mint in a baking dish and complete the preparation adding plenty of vinegar. Enjoy the next day WINE recommended: EST! EAST!! EAST!!! <u>Montefiascone</u> .
Fresh parsley			
Fresh mint			
Clove of garlic		1	
White wine vinegar			
EVO for frying			
Salt			
White pepper to taste			

3. Conclusions

Our recipes revisited in the title, morphologically associated bacteria, reflecting this great tradition of culture and passions, with the use of a zero-kilometer products respecting the territory. Moreover, all this makes us feel fiercely adhering to our roots.

With this a bit "special" approach we wanted to find in the world of "smaller ones" the counterpart that every day we emphasizing, mixing knowledge, Science, Art and Tradition.

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