

Flavor Fusion: Entertainment cooking method changing color and flavor impressions by Ultrasound Levitation

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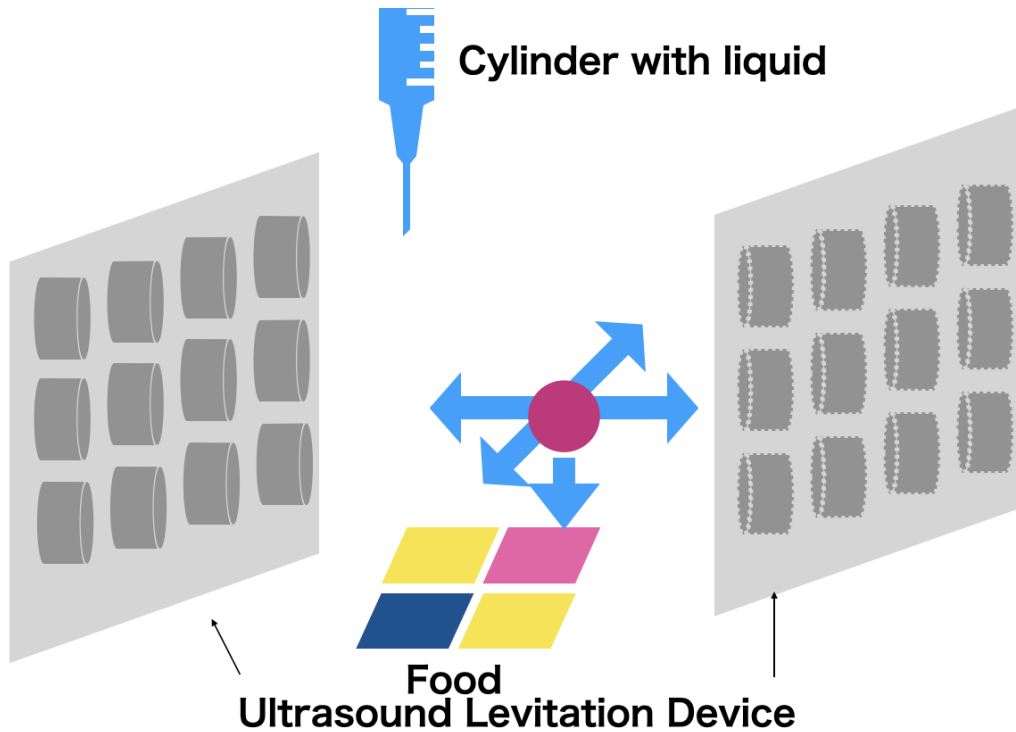


Fig. 1. Figure of Flavor Fusion

We propose a new entertainment cooking device that uses ultrasound levitation to change the taste and colour of food and incorporates visual effects is proposed. The device works by dropping an acidic or alkaline edible liquid onto food coated with a liquid that changes colour according to pH, such as anthocyanins. In doing so, the liquid is dripped onto the food below in a pre-calculated trajectory using ultrasound levitation technology to create a qualifying effect.

In this discussion, we will explore the potential applications and social implications of this new entertainment cooking device.

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53 CCS Concepts: • **Human-centered computing** ! **Human computer interaction(HCI)**.

54 Additional Key Words and Phrases: Flavor, Taste, Cooking, Food, Ultrasound levitation

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62 **1 INTRODUCTION**

63 "Flavor Fusion," an entertainment cooking device that changes taste and color, accompanied by visual presentation
64 using ultrasound levitation, will be proposed.

65 Eating is not only a way for humans to satisfy their physiological needs, but these days it is also becoming a form
66 of entertainment with added staging. People may be looking for experiences that are not only about eating, but also
67 about designing the environment in which they eat (atmosphere, tableware) to what they eat (texture, appearance). For
68 example, projection mapping on tableware[5] or cooking methods based on chemical changes, known as molecular
69 gastronomy, are used in some restaurants.

70 With such a need for an extended means of presentation for meals, research has recently been conducted on food design
71 that includes the use of ultrasound levitation. TastyFloats[8] is a system that uses ultrasound levitation to move the
72 food to the user's mouth.

73 Subjects have also found that bitterness is most difficult to detect when eating with this system, according to
74 their evaluations. Garnish into Thin Air is a new attempt to visually enhance the dining experience using ultrasound
75 levitation[7]. The authors also proposed a food 3D printer based on "spfilication," a technique that wraps an edible
76 membrane around a liquid[1]. Thus, the range of food experience enhancement technologies using ultrasound levitation
77 is expected to expand in the future.

78 This proposal will use its ultrasound levitation and chemical changes to create an entertainment cooking method that
79 changes the taste and color of food according to the user's preferences.
80

82 **2 SYSTEM AND IMPLEMENTATION**

83 **2.1 Ultrasound levitation**

84 Ultrasound levitation attempts to use the acoustic radiation pressure generated by ultrasound waves to levitate and
85 hold objects in a fixed position in space without contact. Applications of ultrasound levitation have been proposed,
86 such as the Constellation Illuminator [2] and spatial projection displays [4]. To achieve this technique, it is necessary to
87 calculate the waveforms output from several ultrasound elements in order to levitate the object at a specified position,
88 and we have used an optimised calculation method called OpenMPD[3] by Roberto et al. to calculate the levitation
89 position of the grains.
90

91 **2.2 Color change by pH**

92 An edible substance that changes colour depending on pH is anthocyanins. Anthocyanins, which are inherently purple,
93 turn pink in acidity and blue or green in alkalinity. When the H⁺ in the water is reduced by neutrality, the H⁺ in
94 anthocyanin pigments is also lost. When this happens, a series of double bonds in =O (carbonyl) formation absorb
95 long-wavelength green light and become purple. When alkaline, the hydroxyl group (OH group) becomes O⁻, which
96

further absorbs long-wave green and red (yellow) light to become blue. Using this reaction, anthocyanins can be added to highly acidic foods, such as lemonade, to turn them pink.

2.3 Influence of visual information on taste perception

There has been much debate on the effects of human visual information on taste[6]. In Vi's study[9], they are examining human taste perception when different lights are irradiated on ultrasonically levitated foods and when odours are injected when eating levitated foods. This time we are more interested in the effect on taste for levitated and colour-changed foods than in the effect on taste when eating levitated foods.

2.4 Entertainment Cooking Device

Flavour Fusion is a technology based on ultrasound levitation, taste and colour change, as explained above. For example, the taste and color of the cocktail can change according to the user's state of mind, as shown in Fig 1. In addition, it does not merely change the color, but also includes a visual effect, as the liquids that are dropped form a circular or irregular trajectory into the cocktail.

This device has three main features.

By controlling the pH concentration, virtually any colour and taste expression is possible.

It uses ultrasound levitation to move the liquid along a three-dimensional path determined by the co-ordinate data.

The liquid is partially atomised by ultrasound, allowing the user to sense its odour.

By developing and validating this demonstration tool, the feasibility of the 'Flavour Fusion' concept can be verified.

3 EXPERIMENT

3.1 Experiment device

Fig 1 shows the experimental device. Open-source ultrasound levitation device[3] provided is placed next to it. A cylinder for outputting liquids and a stepper motor and servomotor for automatic output are installed on the middle of the device. Two cylinders were prepared, one with a sodium alginate solution mixed with citric acid and the other with a sodium alginate solution mixed with baking soda. Then, in the bottom middle of the device, a cracker was placed with a gelatine jelly of anthocyanin-containing butterfly peas.

3.2 Experiment

Output liquids from one or both cylinders. The liquids were then moved to the specified coordinates and tested to see if they could be dropped onto the Butterfly Pea gelatine on the cracker.

3.3 Result

It was confirmed that liquids could be output from one of the cylinders, moved to the previously defined coordinates and dropped onto the cracker. It was also confirmed that the two liquids could be mixed and then dropped onto the cracker.

Fig 3 shows a photograph of the cracker after the experiment. The grains in the front have turned red due to the citric acid. The two crackers in the back can be seen to have turned green due to the baking soda.

