# Palatability Evaluation Study Of Oral Disintegrating Tablets by Human Volunteers

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**ABSTRACT**
The aim of the present investigation was to develop a suitable palatability evaluation study by human volunteers for oral disintegrating tablets (ODT). For this study insoluble and bitter drug like risperidone was selected to evaluate the palatability study efficiency. Palatability study design and procedure developed in healthy male human volunteers and same study design applied for risperidone ODT tablets. Total ten healthy male human volunteers (Age of volunteers in between 25 – 30 years) selected for this palatability evaluation study. For evaluation of the patient's observation, both positive and negative controls also added in palatability evaluation study. Always positive control should get first rank and negative control should get last rank, then only palatability evaluation by the volunteers should be correct. Taste masking agents, taste enhancers and flavors ware used to develop the ODT formulation of risperidone. ODT of risperidone were prepared using different process like lyophilzation and compressed tablets technique. Amberlite was used a taste masking agent. All the formulation showed low weight variation, less disintegration time (less than 30 seconds) and rapid in vitro dissolution. The results revealed that the tablets containing for both the methods had a good palatability for the patients. The optimized formulations showed good palatability by human volunteers, less disintegration time (<30seconds) and release profile with maximum drug being released at all time intervals. It was concluded that risperidone ODT's with improved taste masking and dissolution could be prepared by both lyophilization and compressed tablet technique with suitable taste masking agent like amberlite. The present study demonstrated to suitability of palatability study design by human volunteers and potentials for rapid disintegration in oral cavity with out water, improved taste masking and patient compliance.
**KEYWORDS:** Amberlite, Direct compression, Lyophilization, Oral disintegrating tablets (ODTs), Palatability evaluation study, Risperidone.

## INTRODUCTION

Taste, smell, texture and after taste are important factors in the development of ODT dosage forms. These are important factor in product preference. Good flavor and texture are found to significantly affect sell of the product. Undesirable taste is one of the important formulation problems encountered with most of the drugs. The methods most commonly involved for achieving taste masking include various chemical and physical methods that prevent the drug substance from interaction with taste buds. The simplest method involves use of flavor enhancers. Where these methods fail more complex methodologies are adopted.
The materials for taste masking purpose have often been classified depending upon the basic taste that is masked [1]. Flavoring and perfuming agents can be obtained from either natural or synthetic sources. Natural products include fruit juices, aromatic oils such as peppermint and lemon oils, herbs, spices and distilled fractions of these. They are available as concentrated extracts, alcoholic or aqueous solutions, syrups or spirit [2].
The adsorption of bitter drugs onto synthetic ion exchange resins to achieve taste coverage has been well documented.
Oral disintegrating tablets (ODT) are a new generation of formulations which combine the advantages of both liquid and conventional tablet formulations, and at the same time, offer added advantages over both the traditional dosage forms. They provide the convenience of a tablet formulation and also allow the ease of swallowing provided by a liquid formulation. ODT offer the luxury of much more accurate dosing than

the primary alternative, oral liquids. Designed for dysphagic, geriatric, pediatric, bed-ridden, travelling and psychotic patients who are unable to swallow or refuse to swallow conventional oral formulations [3–5]. As they dissolve/disintegrate very fast when placed in the mouth, ODTs are the most convenient dosage forms for dysphagic, pediatric and geriatric patients with swallowing problem. They do not require water for administration, thus are good alternative for travellers and for bed ridden patients. They simply vanish when placed in the mouth, so cannot be hidden in mouth by psychotic patients. These products not only increase the patient's compliance but also fetch large revenues to manufacturers due to line extension of the existing formulation. In the recent past, several new advanced technologies have been introduced for the formulation of oral disintegrating tablets (ODTs) with very interesting features, like extremely low disintegration time, exceptional taste masking ability, pleasant mouth feel and sugar free tablets for diabetic patients. The technologies utilized for fabrication of ODTs include lyophilization [6], moulding [7], direct compression [8], cotton candy process [9], spray drying [10], sublimation [11], mass extrusion [12], nanonization [13] and quick dissolve film formation [14]. These techniques are based on the principles of increasing porosity and/or addition of superdisintegrants and water soluble excipients in the tablets.

The objective of the present study was to develop correct palatability evaluation study by human volunteers for orally disintegrating tablets of risperidone with lyophilzation and compressed tablet technique.

## MATERIALS

Risperidone API, Amberlite IRP 64 Resin, Gelatin, Glycine USP, Simethicone, Carbomer, Sodium hydroxide NF, Colloidal Silicon Dioxide NF (Aerosol 200), Mannitol NF (Pearlitol SD200), Microcrystalline cellulose NF (Avicel PH 101), Croscarmellose sodium NF (Ac-Di-Sol) Crospovidone NF (Polyplasdone XL 10), Peppermint Flavor Premium 501500 TP0504, Peppermint oil, Menthol, Acesulfame Potassium NF, Aspartame NF, L-Hydroxy Propyl cellulose Type 21, and Sodium Stearyl Fumarate NF (Pruv) were procured from Orchid Healthcare, Irungattikottai, Chennai. All other chemicals and reagent were of analytical grade.

## METHODS

### Formulation of risperidone ODT by lyophilization process

The Oral disintegrating tablets of risperidone were prepared by lyophilization process, amberlite as a taste masking agent, mannitol as a diluent, aspartame as a sweetening agent or taste enhancer, sodium hydroxide as a buffering agent, simethicon as an antifoaming agent, carbomer as a suspending agent, gelatin as a film forming or viscosity increasing agent and peppermint flavor as flavor enhancer. The composition of the each batch was shown in Table 1.

Risperidone and amberlite were weighed and added in deionised water with continuous stirring for 3 hours. Gelatin, glycine, sodium hydroxide, mannitol, peppermint flavor and simethicon were added to the above solution and subjected to stirring for an hour. Finally, carbomer was added to the above solution and stirred for 30 minutes or till the uniform dispersion was obtained. The above dispersion was weighed and distributed in tablet shaped PVDC foil and kept in the lyophilization chamber. The suspension was dried and the dried tablets were collected from the chamber and evaluated the physical and chemical characterization.

### Formulation of Risperidone ODT by compression technique

The Oral disintegrating tablets of risperidone were prepared using the Croscarmellose sodium (Ac-d-sol) and crospovidone (polyplasdone XL 10) as super disintegrates, microcrystalline cellulose (Avicel PH 101) and mannitol as diluents, amberlite as taste masking agent, aspartame and acesulfame potassium as sweetening agents or taste enhancers, peppermint flavor and menthol as a flavor enhancers, L-Hydroxy Propyl cellulose Type 21 as binder, colloidal silicon dioxide and sodium stearyl fumarate (Pruv) as flow promoter. The composition of the each batch was shown in Table 2.

Initially development was started with wet granulation process since risperidone is a low dose molecule (maximum dose is 4mg). Commonly low strength dosage faces dose content uniformity problem and to avoid this, wet granulation process was selected. The raw materials were passed through a #40mesh screen prior to mixing. The amberlite and risperidone dispersed in deionised water under stirring for 3 hours and L-Hydroxy Propyl cellulose Type 21 was added to above drug solution under stirring for 30min. same suspension was used as a granulating fluid. Microcrystalline cellulose (Avicel PH 101), Croscarmellose sodium Ac-Di-Sol and L-Hydroxy Propyl cellulose Type 21 loaded in rapid mixer granulator and dry blend

mixed for 10 min and granulated with above mentioned drug suspension. The wet mass was dried and passed through sieve no. 24. The dried granules were blend with Mannitol SD 200, crospovidone XL 10, peppermint flavor, acesulfame potassium, aspartame, L-Hydroxy Propyl cellulose Type 21, Menthol and Colloidal Silicon Dioxide NF (Aerosol 200) in octagonal blender for sufficient time and finally lubricated with sodium stearyl fumarate (ODTR009 to ODTR016) (Table 1B). The final blend was then compressed into tablets using flat face round 9.0mm tooling on a 16 station tablet machine and tablets were evaluated.

Table 1: Lyophilization process - Composition of different batches of oral disintegrating tablets of risperidone for palatability evaluation study

| Ingredients | ODTR003 | ODTR007 | ODTR008 |
|---|---|---|---|
| Risperidone | 2.0 | 2.0 | 2.0 |
| Amberlite IRP 64 Resin | 4.0 | 6.0 | 6.0 |
| Gelatin | 4.0 | 4.0 | 4.0 |
| Mannitol | 55.7 | 54.7 | 53.7 |
| Glycine | 8.0 | 8.0 | 8.0 |
| Simethicone | 0.4 | 0.4 | 0.4 |
| Aspartame | 0.7 | 0.7 | 0.7 |
| Carbomer | 1.2 | 1.2 | 1.2 |
| Sodium hydroxide | 2.0 | 2.0 | 2.0 |
| Peppermint oil | 2.0 | 1.0 | 2.0 |
| Purified Water | Qs | Qs | Qs |
| Total | 80.0 | 80.0 | 80.0 |

Table 2: Compressed tablet process - Composition of different batches of oral disintegrating tablets of risperidone for palatability evaluation study

| Ingredients | ODTR010 | ODTR014 | ODTR016 | ODTR017 |
|---|---|---|---|---|
| Risperidone | 2.0 | 2.0 | 2.0 | 2.0 |
| Amberlite IRP 64 Resin | 4.0 | 6.0 | 6.0 | 6.0 |
| L-Hydroxy Propyl cellulose Type 21 | 1.0 | 1.0 | 1.0 | 1.0 |
| Deionised Water | Qs | Qs | Qs | Qs |
| Microcrystalline cellulose (Avicel PH 101) | 40.0 | 40.0 | 40.0 | 40.0 |
| Croscarmellose sodium Ac-Di-Sol | 6.0 | 6.0 | 6.0 | 6.0 |
| L-Hydroxy Propyl cellulose Type 21 | 2.0 | 2.0 | 2.0 | 2.0 |
| Mannitol SD 200 | 117.1 | 117.1 | 115.1 | 116.1 |
| Crospovidone XL 10 | 8.0 | 8.0 | 8.0 | 8.0 |
| L-Hydroxy Propyl cellulose Type 21 | 4.0 | 4.0 | 4.0 | 4.0 |
| Aspartame | 0.7 | 0.7 | 0.7 | 0.7 |
| Acesulfame Potassium | 5.0 | 3.0 | 5.0 | 5.0 |
| Peppermint Flavour | 2.0 | 2.0 | 2.0 | 1.0 |
| Menthol | 0.2 | 0.2 | 0.2 | 0.2 |
| Colloidal Silicon Dioxide NF (Aerosol 200) | 2.0 | 2.0 | 2.0 | 2.0 |
| Sodium Stearyl Fumarate NF (Pruv) | 6.0 | 6.0 | 6.0 | 6.0 |
| Total | 200.0 | 200.0 | 200.0 | 200.0 |

**3. Palatability evaluation study**

The objective of this study is to conduct and evaluate the Palatability of different formulations of risperidone oral disintegrating tablets. Risperidone ODT reference is risperdal tablets available in market for this product for comparison of the taste evaluation. Both lyophilized process tablets and compressed process tablets selected for palatability evaluation study, in that one reference formulation, one positive control (Placebo for risperidone) and one is negative control (Placebo for Taste masking agent like amberlite and taste enhancers like aspartame and acesulfame potassium and peppermint flavor) also included.

**3.1. Study requirements**

3.1.1 Test formulations (Table 3A, 3B & 3C)
3.1.2 Non- sweet bread slices
3.1.3 Drinking water
3.1.4 Coca powder

**3.2. For Palatability study of Lyophilized process tablets**

The objective of this study is to conduct and evaluate the Palatability of different formulations of lyophilization process tablets. Risperidone ODT reference is risperdal tablets available in market for this product for comparison of the taste evaluation. Total six formulations were selected for palatability evaluation study, in that one is reference formulation (Risperdal), one is positive control (Placebo for risperidone), one is negative control (Placebo for Taste masking agent like amberlite and taste enhancers like aspartame and acesulfame potassium and peppermint flavor) and three are in house test products. Samples details were mentioned below table 3A.

Table 3A:

| Sr. No. | Test formulations |
|---|---|
| 1 | Positive control |
| 2 | Reference (Risperdal) |
| 3 | Test (ODTR003) |
| 4 | Test (ODTR007) |
| 5 | Test (ODTR008) |
| 6 | Negative control |

**3.3. For Palatability study of compressed process tablets**

The objective of this study is to conduct and evaluate the Palatability of different formulations of compressed method tablets process. Risperidone ODT reference is risperdal, it is a lyophilized form, so this reference was not suitable for this palatability evaluation comparison study. Total six formulations were selected for palatability evaluation study, in that one is positive control (Placebo for risperidone), one is negative control (Placebo for Taste masking agent like amberlite and taste enhancers like aspartame and acesulfame potassium and peppermint flavor) and four are in house test products. Samples details were mentioned below table 3B.

Table 3B:

| Sr. No. | Test formulations |
|---|---|
| 1 | Positive control |
| 2 | Test (ODTR010) |
| 3 | Test (ODTR014) |
| 4 | Test (ODTR016) |
| 5 | Test (ODTR017) |
| 6 | Negative control |

**3.3. For Palatability study final formulation for both the process**

The objective of this study is to compare the palatability of lyophilized process tablets and compressed method tablets process. Total five formulations were selected for palatability evaluation study, in that one is reference (risperdal – lyophilized tablets) formulation, one is positive control (Placebo for risperidone), one is negative control (Placebo for Taste masking agent like amberlite and taste enhancers like aspartame and acesulfame potassium and peppermint flavor), one is in house lyophilized process tablet formulation (Final acceptable formulation by volunteers – table 15A) and one is in house compressed process tablet formulation (Final acceptable formulation by volunteers – table 16C). Samples details were mentioned below table 3C.

Table 3C:

| Sr. No. | Test formulations |
|---|---|
| 1 | Positive control |
| 2 | Reference (Risperdal) |
| 3 | Lyophilized process tablets (ODTR008) |
| 4 | Compressed process tablets (ODTR016) |
| 5 | Negative control |

**3.4 Study Initiation**

**3.4.1** All test formulations shall be assigned a formulation code (Table 4A, 4B & 4C)

3.4.2 All formulations (formulation code) shall be randomized. Each randomization order shall be assigned with sequence code (Table 5A, 5B & 5C)

3.4.3 Palatability study coordinator shall select ten healthy human male volunteers for study and shall assign volunteer code (Table 6A, 6B & 6C)

3.4.4 All ten volunteers shall evaluate all test formulations as per the randomization order (Table 6A, 6B & 6C)

3.4.5 Palatability study coordinator shall monitor the palatability study.

**Formulation Code:**

Table 4A:

| Sr. No | Formulation | Formulation Code |
|---|---|---|
| 1 | Positive control | ODT1 |
| 2 | Reference (Risperdal) | ODT2 |
| 3 | In house tablets (ODTR003) | ODT3 |
| 4 | In house tablets (ODTR007) | ODT4 |
| 5 | In house tablets (ODTR008) | ODT5 |
| 6 | Negative control | ODT6 |

Table 5A:

| Sequence code | Randomization order (Formulation) |
|---|---|
| 1 | ODT1, ODT2, ODT3, ODT4, ODT5 & ODT6 |
| 2 | ODT2, ODT3, ODT4, ODT5, ODT6 & ODT1 |
| 3 | ODT3, ODT4, ODT5, ODT6, ODT1 & ODT2 |
| 4 | ODT4, ODT5, ODT6, ODT1, ODT2 & ODT3 |
| 5 | ODT5, ODT6, ODT1, ODT2, ODT3 & ODT4 |
| 6 | ODT6, ODT1, ODT2, ODT3, ODT4 & ODT5 |

Table 6A:

| Volunteer Code | Volunteer Name | Frequency Number | Randomization order (Formulation) |
|---|---|---|---|
| A | Senthil Kumar (TT) | 1 | ODT1, ODT2, ODT3, ODT4, ODT5 & ODT6 |
| B | Murugan M | 2 | ODT2, ODT3, ODT4, ODT5, ODT6 & ODT1 |
| C | E. Venkatesan | 3 | ODT3, ODT4, ODT5, ODT6, ODT1 & ODT2 |
| D | N. Srinivasan | 4 | ODT4, ODT5, ODT6, ODT1, ODT2 & ODT3 |
| E | P. Dhinakar Reddy | 5 | ODT5, ODT6, ODT1, ODT2, ODT3 & ODT4 |
| F | Maheswar Kolliri | 6 | ODT6, ODT1, ODT2, ODT3, ODT4 & ODT5 |
| G | Surendra Singh | 1 | ODT1, ODT2, ODT3, ODT4, ODT5 & ODT6 |
| H | Sella Senthil | 2 | ODT2, ODT3, ODT4, ODT5, ODT6 & ODT1 |
| I | M. K. Thinakar | 3 | ODT3, ODT4, ODT5, ODT6, ODT1 & ODT2 |
| J | M. N. Siva Kumar | 4 | ODT4, ODT5, ODT6, ODT1, ODT2 & ODT3 |

**Formulation Code:**

Table 4B:

| Sr. No | Formulation | Formulation Code |
|---|---|---|
| 1 | Positive control | ODT7 |
| 2 | In house tablets (ODTR010) | ODT8 |
| 3 | In house tablets (ODTR014) | ODT9 |
| 4 | In house tablets (ODTR016) | ODT10 |
| 5 | In house tablets (ODTR017) | ODT11 |
| 6 | Negative control | ODT12 |

Table 5B:

| Sequence code | Randomization order (Formulation) |
|---|---|
| 7 | ODT7, ODT8, ODT9, ODT10, ODT11 & ODT12 |
| 8 | ODT8, ODT9, ODT10, ODT11, ODT12 & ODT7 |
| 9 | ODT9, ODT10, ODT11, ODT12, ODT7 & ODT8 |
| 10 | ODT10, ODT11, ODT12, ODT7, ODT8 & ODT9 |
| 11 | ODT11, ODT12, ODT7, ODT8, ODT9 & ODT10 |
| 12 | ODT12, ODT7, ODT8, ODT9, ODT10 & ODT11 |

Table 6B:

| Volunteer Code | Volunteer Name | Frequency Number | Randomization order (Formulation) |
|---|---|---|---|
| A | Senthil Kumar (TT) | 7 | ODT7, ODT8, ODT9, ODT10, ODT11 & ODT12 |
| B | Murugan M | 8 | ODT8, ODT9, ODT10, ODT11, ODT12 & ODT7 |
| C | E. Venkatesan | 9 | ODT9, ODT10, ODT11, ODT12, ODT7 & ODT8 |
| D | N. Srinivasan | 10 | ODT10, ODT11, ODT12, ODT7, ODT8 & ODT9 |
| E | P. Dhinakar Reddy | 11 | ODT11, ODT12, ODT7, ODT8, ODT9 & ODT10 |
| F | Maheswar Kolliri | 12 | ODT12, ODT7, ODT8, ODT9, ODT10 & ODT11 |
| G | Surendra Singh | 7 | ODT7, ODT8, ODT9, ODT10, ODT11 & ODT12 |
| H | Sella Senthil | 8 | ODT8, ODT9, ODT10, ODT11, ODT12 & ODT7 |
| I | M. K. Thinakar | 9 | ODT9, ODT10, ODT11, ODT12, ODT7 & ODT8 |
| J | M. N. Siva Kumar | 10 | ODT10, ODT11, ODT12, ODT7, ODT8 & ODT9 |

**Formulation Code:**

Table 4C:

| Sr. No | Formulation | Formulation Code |
|---|---|---|
| 1 | Positive control | ODT13 |
| 2 | Reference (Risperdal) | ODT14 |
| 3 | Lyophilized process tablets (ODTR008) | ODT15 |
| 4 | Compressed process tablets (ODTR016) | ODT16 |
| 5 | Negative control | ODT17 |

Table 5C:

| Sequence code | Randomization order (Formulation) |
|---|---|
| 13 | ODT13, ODT14, ODT15, ODT16 & ODT17 |
| 14 | ODT14, ODT15, ODT16, ODT17 & ODT13 |
| 15 | ODT15, ODT16, ODT17, ODT13 & ODT14 |
| 16 | ODT16, ODT17, ODT13, ODT14 & ODT15 |
| 17 | ODT17, ODT13, ODT14, ODT15 & ODT16 |

Table 6C:

| Volunteer Code | Volunteer Name | Frequency Number | Randomization order (Formulation) |
|---|---|---|---|
| A | Senthil Kumar (TT) | 13 | ODT13, ODT14, ODT15, ODT16 & ODT17 |
| B | Murugan M | 14 | ODT14, ODT15, ODT16, ODT17 & ODT13 |
| C | E. Venkatesan | 15 | ODT15, ODT16, ODT17, ODT13 & ODT14 |
| D | N. Srinivasan | 16 | ODT16, ODT17, ODT13, ODT14 & ODT15 |
| E | P. Dhinakar Reddy | 17 | ODT17, ODT13, ODT14, ODT15 & ODT16 |
| F | Maheswar Kolliri | 13 | ODT13, ODT14, ODT15, ODT16 & ODT17 |
| G | Surendra Singh | 14 | ODT14, ODT15, ODT16, ODT17 & ODT13 |
| H | Sella Senthil | 15 | ODT15, ODT16, ODT17, ODT13 & ODT14 |
| I | M. K. Thinakar | 16 | ODT16, ODT17, ODT13, ODT14 & ODT15 |
| J | M. N. Siva Kumar | 17 | ODT17, ODT13, ODT14, ODT15 & ODT16 |

**3.5 Instructions to Palatability study Co-coordinator**

3.5.1 Collect the selected batch Oral tablets as indicated on the table 3A, 3B & 3C.
3.5.2 Each of the test formulations shall be transferred to HDPE battles labeled only with formulation code, as per Table 4A, 4B & 4C
3.5.3 Palatability study coordinator shall provide the copy of the Palatability evaluation feedback form (Table 7, 8A, 8B, 9A & 9B) to the volunteer and explain instructions to volunteers before starting study.
3.5.4 Palatability study coordinator shall provide one dose (one tablet) to volunteer from each test formulation for palatability study evaluation.
3.5.5 The time interval between evaluations of each test formulation in the same volunteer is at least 30 minutes and mention the starting time for each formulation in Table 10A & 10B.
3.5.6 After evaluating each formulation, one half of a bread slice shall be given to each volunteer followed by half glass of water and coca powder.
3.5.7 Palatability study coordinator shall collect the filled palatability evaluation feedback forms (Table 7, 8A, 8B, 9A & 9B) from all the ten volunteers.
3.5.8 Palatability study coordinator shall compile the data and evaluate the formulations.

**3.6 Instructions to Volunteers**

3.6.1 Please read all instructions carefully before proceeding for evaluation.
3.6.2 Take one tablet (one dose) in to the mouth (Do not swallow the tablet) and wait for 30 seconds. After 30 seconds spit the tablet (Do not wash the mouth), record the feedback in Table 8A & 8B based on the table in Table 7.
3.6.3 After spitting the table, wait for 5minutes and record the feedback in Table 9A & 9B based on the table in Table 7.
3.6.4 During this 5minutes period do not wash the mouth cavity or eat anything.
3.6.5 After recording the feedback at the end of 5minutes thoroughly wash the mouth cavity with water and eat the bread slice and coca powder provided by the study coordinator.
3.6.6 Till the entire test formulations are evaluated, the volunteer shall not eat anything other than that provided during the study.

Table 7:

| Point | Initial taste | | After taste | | Mouth feel | Flavor | Overall acceptability |
|---|---|---|---|---|---|---|---|
| | Bitterness | Sweetness | Bitterness | Sweetness | | | |
| 1 | Extremely bitter | Not at all sweet | Extremely bitter | Not at all sweet | Very gritty | Very unpleasant | Worst |
| 2 | Highly bitter | Very slightly sweet | Highly bitter | Very slightly sweet | Gritty | Unpleasant | Poor |
| 3 | Acceptable / tolerable | Acceptable / tolerable | Acceptable / tolerable | Acceptable / tolerable | Acceptable | Acceptable | Acceptable |
| 4 | Very slightly bitter | Highly sweet | Very slightly bitter | Highly sweet | Creamy | Pleasant | Good |
| 5 | Not at all bitter | Extremely sweet | Not at all bitter | Extremely sweet | Very creamy | Very pleasant | Very good |

**Feedback - After 30 seconds**

Table 8A:

| Formulation code | Initial taste | | | | | | | | | | Mouth feel | | | | | Flavor | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bitterness | | | | | Sweetness | | | | | | | | | | | | | | |
| | Extremely bitter ► Not at all bitter | | | | | Not at all sweet ► Extremely sweet | | | | | Very gritty ► Very creamy | | | | | Very unpleasant ► Very pleasant | | | | |
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| ODT1 | | | | | | | | | | | | | | | | | | | | |
| ODT2 | | | | | | | | | | | | | | | | | | | | |
| ODT3 | | | | | | | | | | | | | | | | | | | | |
| ODT4 | | | | | | | | | | | | | | | | | | | | |
| ODT5 | | | | | | | | | | | | | | | | | | | | |
| ODT6 | | | | | | | | | | | | | | | | | | | | |
| ODT7 | | | | | | | | | | | | | | | | | | | | |
| ODT8 | | | | | | | | | | | | | | | | | | | | |
| ODT9 | | | | | | | | | | | | | | | | | | | | |
| ODT10 | | | | | | | | | | | | | | | | | | | | |
| ODT11 | | | | | | | | | | | | | | | | | | | | |
| ODT12 | | | | | | | | | | | | | | | | | | | | |

Table 8B:

| Formulation code | Initial taste | | | | | | | | | | Mouth feel | | | | | Flavor | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bitterness | | | | | Sweetness | | | | | | | | | | | | | | |
| | Extremely bitter ► Not at all bitter | | | | | Not at all sweet ► Extremely sweet | | | | | Very gritty ► Very creamy | | | | | Very unpleasant ► Very pleasant | | | | |
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| ODT13 | | | | | | | | | | | | | | | | | | | | |
| ODT14 | | | | | | | | | | | | | | | | | | | | |
| OD15 | | | | | | | | | | | | | | | | | | | | |
| ODT16 | | | | | | | | | | | | | | | | | | | | |
| ODT17 | | | | | | | | | | | | | | | | | | | | |

**Feedback – After 5 minutes**

Table 9A:

| Formulation code | After taste | | | | | | | | | | Overall acceptability | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bitterness | | | | | Sweetness | | | | | | | | | |
| | Extremely bitter ► Not at all bitter | | | | | Not at all sweet ► Extremely sweet | | | | | Worst ► Very good | | | | |
| ODT1 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| ODT2 | | | | | | | | | | | | | | | |
| ODT3 | | | | | | | | | | | | | | | |
| ODT4 | | | | | | | | | | | | | | | |
| ODT5 | | | | | | | | | | | | | | | |
| ODT6 | | | | | | | | | | | | | | | |
| ODT7 | | | | | | | | | | | | | | | |
| ODT8 | | | | | | | | | | | | | | | |
| ODT9 | | | | | | | | | | | | | | | |
| ODT10 | | | | | | | | | | | | | | | |
| ODT11 | | | | | | | | | | | | | | | |
| ODT12 | | | | | | | | | | | | | | | |

Table 9B:

| Formulation code | After taste | | | | | | | | | | Overall acceptability | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bitterness | | | | | Sweetness | | | | | | | | | |
| | Extremely bitter ► Not at all bitter | | | | | Not at all sweet ► Extremely sweet | | | | | Worst ► Very good | | | | |
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| ODT13 | | | | | | | | | | | | | | | |
| ODT14 | | | | | | | | | | | | | | | |
| OD15 | | | | | | | | | | | | | | | |
| ODT16 | | | | | | | | | | | | | | | |
| ODT17 | | | | | | | | | | | | | | | |

**Study time**

Table 10A:

| Volunteer code | Study start time – 10.02.2009 | | | | | |
|---|---|---|---|---|---|---|
| | ODT1 | ODT2 | ODT3 | ODT4 | ODT5 | ODT6 |
| A | 9.40 | 10.20 | 11.10 | 12.00 | 2.25 | 3.10 |
| B | 10.20 | 11.10 | 12.00 | 2.25 | 3.10 | 9.40 |
| C | 11.10 | 12.00 | 2.25 | 3.10 | 9.40 | 10.20 |
| D | 12.00 | 2.25 | 3.10 | 9.40 | 10.20 | 11.10 |
| E | 2.25 | 3.10 | 9.40 | 10.20 | 11.10 | 12.00 |
| F | 3.10 | 9.40 | 10.20 | 11.10 | 12.00 | 2.25 |
| G | 9.45 | 10.25 | 11.15 | 12.05 | 2.30 | 3.15 |
| H | 10.25 | 11.15 | 12.05 | 2.30 | 3.15 | 9.45 |
| I | 11.15 | 12.05 | 2.30 | 3.15 | 9.45 | 10.25 |
| J | 12.05 | 2.30 | 3.15 | 9.45 | 10.25 | 11.15 |

Table 10B:

| Volunteer code | Study start time - 11.02.2009 | | | | | |
|---|---|---|---|---|---|---|
| | ODT7 | ODT8 | ODT9 | ODT10 | ODT11 | ODT12 |
| A | 10.00 | 10.35 | 11.10 | 11.45 | 12.20 | 12.50 |
| B | 10.10 | 10.45 | 11.20 | 11.55 | 12.30 | 13.10 |
| C | 10.20 | 10.55 | 11.30 | 12.05 | 12.40 | 13.20 |
| D | 10.30 | 11.05 | 11.40 | 12.15 | 12.50 | 13.30 |
| E | 10.40 | 11.15 | 11.50 | 12.25 | 13.00 | 13.40 |
| F | 10.00 | 10.35 | 11.10 | 11.45 | 12.20 | 12.50 |
| G | 10.10 | 10.45 | 11.20 | 11.55 | 12.30 | 13.10 |
| H | 10.20 | 10.55 | 11.30 | 12.05 | 12.40 | 13.20 |
| I | 10.30 | 11.05 | 11.40 | 12.15 | 12.50 | 13.30 |
| J | 10.40 | 11.15 | 11.50 | 12.25 | 13.00 | 13.40 |

Table 10C:

| Volunteer code | Study start time - 12.02.2009 | | | | |
|---|---|---|---|---|---|
| | ODT13 | ODT14 | ODT15 | ODT16 | ODT17 |
| A | 9.30 | 10.10 | 10.50 | 11.30 | 12.10 |
| B | 9.40 | 10.20 | 11.00 | 11.40 | 12.20 |
| C | 9.50 | 10.30 | 11.10 | 11.50 | 12.30 |
| D | 10.00 | 10.40 | 11.20 | 12.00 | 12.40 |
| E | 10.10 | 10.50 | 11.30 | 12.10 | 12.50 |
| F | 9.30 | 10.10 | 10.50 | 11.30 | 12.10 |
| G | 9.40 | 10.20 | 11.00 | 11.40 | 12.20 |
| H | 9.50 | 10.30 | 11.10 | 11.50 | 12.30 |
| I | 10.00 | 10.40 | 11.20 | 12.00 | 12.40 |
| J | 10.10 | 10.50 | 11.30 | 12.10 | 12.50 |

Note: Each formulation should maintain minimum 30 minutes time gap for neutralization of the taste buds

3.6 Data interpretation
3.6.1 Palatability study coordinator shall enter the data in Palatability evaluation data analysis (Table 11A, 11B, 12A & 12B) based on the Palatability evaluation feedback (Table 7, 8A, 8B, 9A & 9B)
3.6.2 Palatability study coordinator shall evaluate the following particulars for each test formulations
3.6.2.1 Average points.
3.6.2.2 Standard deviation.
3.6.2.3 Preference calculated points for Evaluation parameters.
3.6.2.4 Total calculated points
3.6.3 Palatability study coordinator shall enter the average value for each test formulations and Palatability evaluation data compilations in Table 13A & 13B based on the Palatability evaluation data analysis (Table 11A, 11B, 12A & 12B).
3.6.4 Palatability study coordinator shall give the value for each evaluation parameters (Table 14) and calculate the each evaluation parameter average value with the same (Table 15A & 15B).
3.6.4 Palatability study coordinator shall allot the acceptance and rank to each test formulation (Table 17A, 17B & 17C) based on the total calculated value of the each test formulation (Table 15A & 15B) and Palatability evaluation scale (Table 16).

**Palatability Evaluation Data Analysis**

Feedback: After 30 seconds

Table 11A:

| | Formulation code | A | B | C | D | E | F | G | H | I | J | Avg. | Std dev |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bitterness | ODT1 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4.9 | 0.3 |
| | ODT2 | 5 | 5 | 4 | 5 | 4 | 5 | 4 | 4 | 5 | 4 | 4.5 | 0.5 |
| | ODT3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2.6 | 0.5 |
| | ODT4 | 4 | 4 | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 5 | 4.6 | 0.5 |
| | ODT5 | 5 | 4 | 5 | 4 | 5 | 5 | 5 | 4 | 5 | 5 | 4.7 | 0.5 |
| | ODT6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | ODT7 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4.9 | 0.3 |
| | ODT8 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 2.5 | 0.5 |
| | ODT9 | 4 | 3 | 4 | 4 | 3 | 3 | 4 | 3 | 3 | 4 | 3.5 | 0.5 |
| | ODT10 | 5 | 4 | 5 | 4 | 5 | 4 | 4 | 5 | 5 | 4 | 4.5 | 0.5 |
| | ODT11 | 5 | 4 | 5 | 4 | 5 | 5 | 4 | 5 | 4 | 4 | 4.5 | 0.5 |
| | ODT12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Sweetness | ODT1 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 |
| | ODT2 | 5 | 4 | 4 | 4 | 5 | 5 | 4 | 5 | 5 | 5 | 4.6 | 0.5 |
| | ODT3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2.6 | 0.5 |
| | ODT4 | 4 | 5 | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 4 | 4.3 | 0.5 |
| | ODT5 | 5 | 4 | 5 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 4.6 | 0.5 |
| | ODT6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | ODT7 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 |
| | ODT8 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2.5 | 0.5 |
| | ODT9 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 4 | 4.2 | 0.4 |
| | ODT10 | 5 | 4 | 4 | 5 | 5 | 4 | 4 | 5 | 4 | 5 | 4.5 | 0.5 |
| | ODT11 | 5 | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 4 | 5 | 4.4 | 0.5 |
| | ODT12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Flavor | ODT1 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 |
| | ODT2 | 5 | 4 | 4 | 5 | 4 | 4 | 4 | 5 | 4 | 4 | 4.3 | 0.5 |
| | ODT3 | 4 | 4 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4.2 | 0.4 |
| | ODT4 | 3 | 4 | 3 | 3 | 2 | 4 | 3 | 3 | 2 | 3 | 3 | 0.6 |
| | ODT5 | 5 | 4 | 4 | 5 | 5 | 4 | 5 | 5 | 4 | 5 | 4.6 | 0.5 |
| | ODT6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | ODT7 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 |
| | ODT8 | 4 | 4 | 4 | 5 | 5 | 4 | 5 | 4 | 4 | 4 | 4.3 | 0.5 |
| | ODT9 | 4 | 5 | 5 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4.3 | 0.5 |
| | ODT10 | 5 | 5 | 4 | 4 | 5 | 5 | 4 | 5 | 4 | 5 | 4.6 | 0.5 |
| | ODT11 | 3 | 3 | 4 | 4 | 3 | 4 | 3 | 3 | 4 | 4 | 3.5 | 0.5 |
| | ODT12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Mouth Feel | ODT1 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 |
| | ODT2 | 5 | 5 | 5 | 4 | 5 | 5 | 4 | 5 | 5 | 5 | 4.8 | 0.4 |
| | ODT3 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 3.6 | 0.5 |
| | ODT4 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2.8 | 0.4 |
| | ODT5 | 5 | 5 | 5 | 4 | 4 | 5 | 4 | 5 | 4 | 5 | 4.6 | 0.5 |
| | ODT6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | ODT7 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 |
| | ODT8 | 3 | 4 | 3 | 4 | 3 | 3 | 3 | 4 | 3 | 4 | 3.4 | 0.5 |
| | ODT9 | 4 | 3 | 3 | 4 | 4 | 4 | 3 | 3 | 3 | 4 | 3.5 | 0.5 |
| | ODT10 | 4 | 4 | 4 | 5 | 5 | 5 | 4 | 5 | 5 | 4 | 4.5 | 0.5 |
| | ODT11 | 3 | 3 | 3 | 3 | 2 | 3 | 4 | 4 | 4 | 4 | 3.3 | 0.6 |
| | ODT12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |

Table 11B:

| | Formulation code | A | B | C | D | E | F | G | H | I | J | Avg. | Std dev |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bitterness | ODT13 | 5 | 5 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 4.7 | 0.5 |
| | ODT14 | 5 | 5 | 4 | 4 | 4 | 5 | 4 | 4 | 5 | 4 | 4.4 | 0.5 |
| | ODT15 | 5 | 4 | 4 | 4 | 5 | 5 | 5 | 4 | 4 | 5 | 4.5 | 0.5 |
| | ODT16 | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 4 | 5 | 4 | 4.3 | 0.5 |
| | ODT17 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Sweetness | ODT13 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 |
| | ODT14 | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 5 | 5 | 5 | 4.5 | 0.5 |
| | ODT15 | 5 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 4 | 5 | 4.4 | 0.5 |
| | ODT16 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 5 | 4 | 5 | 4.3 | 0.5 |
| | ODT17 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Flavor | ODT13 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 |
| | ODT14 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 5 | 4 | 4 | 4.2 | 0.4 |
| | ODT15 | 4 | 4 | 4 | 5 | 5 | 4 | 5 | 5 | 4 | 4 | 4.4 | 0.5 |
| | ODT16 | 5 | 5 | 4 | 4 | 5 | 5 | 4 | 5 | 4 | 5 | 4.6 | 0.5 |
| | ODT17 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1.2 | 0.4 |
| Mouth Feel | ODT13 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 |
| | ODT14 | 5 | 5 | 5 | 4 | 5 | 5 | 4 | 5 | 5 | 4 | 4.7 | 0.5 |
| | ODT15 | 5 | 5 | 5 | 4 | 4 | 5 | 4 | 5 | 4 | 5 | 4.6 | 0.5 |
| | ODT16 | 4 | 4 | 4 | 4 | 5 | 5 | 4 | 5 | 4 | 4 | 4.3 | 0.5 |
| | ODT17 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |

Feedback: After 30 seconds

**Feedback – After 5 minutes**

Table 12A:

| | Formulation code | A | B | C | D | E | F | G | H | I | J | Avg. | Std dev |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bitterness | ODT1 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 4.9 | 0.3 |
| | ODT2 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 5 | 5 | 4 | 4.5 | 0.5 |
| | ODT3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2.7 | 0.5 |
| | ODT4 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4.2 | 0.4 |
| | ODT5 | 5 | 4 | 5 | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 4.4 | 0.5 |
| | ODT6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1.1 | 0.3 |
| | ODT7 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 4.9 | 0.3 |
| | ODT8 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 2.6 | 0.5 |
| | ODT9 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 5 | 3.9 | 0.5 |
| | ODT10 | 4 | 5 | 4 | 5 | 4 | 4 | 5 | 4 | 4 | 5 | 4.4 | 0.5 |
| | ODT11 | 4 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4.2 | 0.4 |
| | ODT12 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1.1 | 0.3 |
| Sweetness | ODT1 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 |
| | ODT2 | 4 | 5 | 4 | 4 | 5 | 5 | 4 | 5 | 4 | 5 | 4.5 | 0.5 |
| | ODT3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 4 | 2 | 2.8 | 0.6 |
| | ODT4 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 5 | 4.2 | 0.4 |
| | ODT5 | 5 | 5 | 4 | 5 | 4 | 5 | 5 | 4 | 4 | 4 | 4.5 | 0.5 |
| | ODT6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | ODT7 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 |
| | ODT8 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 2.6 | 0.5 |
| | ODT9 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 4 | 4.2 | 0.6 |
| | ODT10 | 5 | 4 | 5 | 4 | 5 | 5 | 4 | 4 | 4 | 5 | 4.5 | 0.5 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ODT11 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 3 | 4 | 4 | 0.4 |
| | ODT12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Overall Acceptability | ODT1 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 |
| | ODT2 | 5 | 5 | 4 | 4 | 5 | 5 | 4 | 5 | 4 | 5 | 4.6 | 0.5 |
| | ODT3 | 4 | 3 | 3 | 3 | 4 | 4 | 3 | 2 | 3 | 4 | 3.3 | 0.6 |
| | ODT4 | 3 | 4 | 4 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3.1 | 0.5 |
| | ODT5 | 5 | 4 | 5 | 5 | 4 | 4 | 4 | 4 | 5 | 5 | 4.5 | 0.5 |
| | ODT6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | ODT7 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 |
| | ODT8 | 4 | 3 | 3 | 4 | 3 | 4 | 3 | 3 | 4 | 3 | 3.4 | 0.5 |
| | ODT9 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 3 | 4 | 5 | 3.9 | 0.5 |
| | ODT10 | 4 | 5 | 5 | 4 | 5 | 5 | 4 | 4 | 5 | 5 | 4.6 | 0.5 |
| | ODT11 | 4 | 3 | 3 | 3 | 4 | 3 | 4 | 4 | 3 | 3 | 3.4 | 0.5 |
| | ODT12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |

Table 12B:

| | Formulation code | A | B | C | D | E | F | G | H | I | J | Avg. | Std dev |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bitterness | ODT13 | 5 | 5 | 5 | 4 | 5 | 5 | 4 | 5 | 5 | 4 | 4.7 | 0.5 |
| | ODT14 | 5 | 4 | 5 | 4 | 4 | 4 | 4 | 5 | 5 | 4 | 4.4 | 0.5 |
| | ODT15 | 4 | 4 | 5 | 5 | 4 | 4 | 4 | 4 | 5 | 5 | 4.4 | 0.5 |
| | ODT16 | 4 | 4 | 4 | 5 | 4 | 4 | 5 | 4 | 4 | 5 | 4.3 | 0.5 |
| | ODT17 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Sweetness | ODT13 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 4.8 | 0.4 |
| | ODT14 | 4 | 5 | 4 | 4 | 5 | 5 | 4 | 5 | 4 | 4 | 4.4 | 0.5 |
| | ODT15 | 4 | 5 | 4 | 5 | 4 | 4 | 5 | 4 | 4 | 4 | 4.3 | 0.5 |
| | ODT16 | 5 | 4 | 5 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 4.3 | 0.5 |
| | ODT17 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Overall Acceptability | ODT13 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 0 |
| | ODT14 | 4 | 5 | 4 | 4 | 5 | 5 | 4 | 5 | 4 | 5 | 4.5 | 0.5 |
| | ODT15 | 5 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 5 | 4.3 | 0.5 |
| | ODT16 | 4 | 5 | 4 | 4 | 5 | 5 | 4 | 4 | 4 | 5 | 4.4 | 0.5 |
| | ODT17 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |

## Palatability Evaluation Data Compilation

Feedback: After 30 seconds

Table 13A:

| Formulation Code | Average Points by Volunteers | | | | | | |
|---|---|---|---|---|---|---|---|
| | After 30 seconds | | | | After 5 minutes | | |
| | Initial taste | | Mouth feel | Flavor | After taste | | Overall Acceptability |
| | Bitterness | Sweetness | | | Bitterness | Sweetness | |
| ODT1 | 4.9 | 5 | 5 | 5 | 4.9 | 5 | 5 |
| ODT2 | 4.5 | 4.6 | 4.8 | 4.3 | 4.5 | 4.5 | 4.6 |
| ODT3 | 2.6 | 2.6 | 3.6 | 4.2 | 2.7 | 2.8 | 3.3 |
| ODT4 | 4.6 | 4.3 | 2.8 | 3 | 4.2 | 4.2 | 3.1 |
| ODT5 | 4.7 | 4.6 | 4.6 | 4.6 | 4.4 | 4.5 | 4.5 |
| ODT6 | 1 | 1 | 1 | 1 | 1.1 | 1 | 1 |
| ODT7 | 4.9 | 5 | 5 | 5 | 4.9 | 5 | 5 |
| ODT8 | 2.5 | 2.5 | 3.4 | 4.3 | 2.6 | 2.6 | 3.4 |
| ODT9 | 3.5 | 4.2 | 3.5 | 4.3 | 3.9 | 4.2 | 3.9 |
| ODT10 | 4.5 | 4.5 | 4.5 | 4.6 | 4.4 | 4.5 | 4.6 |
| ODT11 | 4.5 | 4.4 | 3.3 | 3.5 | 4.2 | 4 | 3.4 |
| ODT12 | 1 | 1 | 1 | 1 | 1.1 | 1 | 1 |

Table 13B:

| Formulation Code | Average Points by Volunteers | | | | | | |
|---|---|---|---|---|---|---|---|
| | After 30 seconds | | | | After 5 minutes | | |
| | Initial taste | | Mouth feel | Flavor | After taste | | Overall Acceptability |
| | Bitterness | Sweetness | | | Bitterness | Sweetness | |
| ODT1 | 4.7 | 5 | 5 | 5 | 4.7 | 4.8 | 5 |
| ODT2 | 4.4 | 4.5 | 4.2 | 4.7 | 4.4 | 4.4 | 4.5 |
| ODT3 | 4.5 | 4.4 | 4.4 | 4.6 | 4.4 | 4.3 | 4.3 |
| ODT4 | 4.3 | 4.3 | 4.6 | 4.3 | 4.3 | 4.3 | 4.4 |
| ODT5 | 1 | 1 | 1.2 | 1 | 1 | 1 | 1 |

Table 14:

| Sr. No | Evaluation parameter | Value of the parameter |
|---|---|---|
| 1 | After 30 seconds Bitterness | 3 |
| 2 | After 30 seconds Sweetness | 3 |
| 3 | After 30 seconds Mouth feels | 3 |
| 4 | Flavor | 2 |
| 5 | After 5 minutes Bitterness | 3 |
| 6 | After 5 minutes Sweetness | 3 |
| 7 | Overall acceptability | 3 |

Table 15A:

| Formulation Code | Average Points with calculated points | | | | | | | Total points |
|---|---|---|---|---|---|---|---|---|
| | After 30 seconds | | | | After 5 minutes | | | |
| | Initial taste | | Mouth feel | Flavor | After taste | | Overall Acceptability | |
| | Bitterness | Sweetness | | | Bitterness | Sweetness | | |
| ODT1 | 14.7 | 15 | 15 | 10 | 14.7 | 15 | 15 | 99.4 |
| ODT2 | 13.5 | 13.8 | 14.4 | 8.6 | 13.5 | 13.5 | 13.8 | 91.1 |
| ODT3 | 7.8 | 7.8 | 10.8 | 8.4 | 8.1 | 8.4 | 9.9 | 61.2 |
| ODT4 | 13.8 | 12.9 | 8.4 | 6 | 12.6 | 12.6 | 9.3 | 75.6 |
| ODT5 | 14.1 | 13.8 | 13.8 | 9.2 | 13.2 | 13.5 | 13.5 | 91.1 |
| ODT6 | 3 | 3 | 3 | 2 | 3.3 | 3 | 3 | 20.3 |
| ODT7 | 14.7 | 15 | 15 | 10 | 14.7 | 15 | 15 | 99.4 |
| ODT8 | 7.5 | 7.5 | 10.2 | 8.6 | 7.8 | 7.8 | 10.2 | 59.6 |
| ODT9 | 10.5 | 12.6 | 10.5 | 8.6 | 11.7 | 12.6 | 11.7 | 78.2 |
| ODT10 | 13.5 | 13.5 | 13.5 | 9.2 | 13.2 | 13.5 | 13.8 | 90.2 |
| ODT11 | 13.5 | 13.2 | 9.9 | 7 | 12.6 | 12 | 10.2 | 78.4 |
| ODT12 | 3 | 3 | 3 | 2 | 3.3 | 3 | 3 | 20.3 |

Table 15B:

| Formulation Code | Average Points with calculated points | | | | | | | Total points |
|---|---|---|---|---|---|---|---|---|
| | After 30 seconds | | | | After 5 minutes | | | |
| | Initial taste | | Mouth feel | Flavor | After taste | | Overall Acceptability | |
| | Bitterness | Sweetness | | | Bitterness | Sweetness | | |
| ODT1 | 14.1 | 15 | 10 | 15 | 14.1 | 14.4 | 15 | 97.6 |
| ODT2 | 13.2 | 13.5 | 8.4 | 14.1 | 13.2 | 13.2 | 13.5 | 89.1 |
| ODT3 | 13.5 | 13.2 | 8.8 | 13.8 | 13.2 | 12.9 | 12.9 | 88.3 |
| ODT4 | 12.9 | 12.9 | 9.2 | 12.9 | 12.9 | 12.9 | 13.2 | 86.9 |
| ODT5 | 3 | 3 | 2.4 | 3 | 3 | 3 | 3 | 20.4 |

Note: Formulation with higher average points will be given first rank except bitterness (For bitterness lower points will be given first rank).

**Table 16: Palatability evaluation scale:**

| Sr. No. | Total points | Acceptability | Rank |
|---|---|---|---|
| 1 | 90 - 100 | Very Good | 1 |
| 2 | 80 - 90 | Good | 2 |
| 3 | 60 - 80 | Acceptable | 3 |
| 4 | 40 - 60 | Poor | 4 |
| 5 | Below 40 | Worst | 5 |

**Overall summary report of taste evaluation study**

Table 17A:

| **Formulation Code** | **Formulation** | Calculated points | **Overall Ranking** | Acceptability |
|---|---|---|---|---|
| ODT1 | Positive control | 99.4 | 1 | Very Good |
| ODT2 | Reference (Risperdal) | 91.1 | 2 | Very Good |
| ODT3 | In house tablets (ODTR003) | 61.2 | 5 | Acceptable |
| ODT4 | In house tablets (ODTR007) | 75.6 | 4 | Acceptable |
| ODT5 | In house tablets (ODTR008) | 91.1 | 2 | Very Good |
| ODT6 | Negative control | 20.3 | 6 | Worst |

Table 17B:

| **Formulation Code** | **Formulation** | Calculated points | **Overall Ranking** | Acceptability |
|---|---|---|---|---|
| ODT7 | Positive control | 99.4 | 1 | Very Good |
| ODT8 | In house tablets (ODTR010) | 59.6 | 5 | Poor |
| ODT9 | In house tablets (ODTR014) | 78.2 | 4 | Acceptable |
| ODT10 | In house tablets (ODTR016) | 90.2 | 2 | Very Good |
| ODT11 | In house tablets (ODTR017) | 78.4 | 3 | Acceptable |
| ODT12 | Negative control | 20.3 | 6 | Worst |

Table 17C:

| **Formulation Code** | **Formulation** | Calculated points | **Overall Ranking** | Acceptability |
|---|---|---|---|---|
| ODT13 | Positive control | 97.6 | 1 | Very Good |
| ODT14 | Reference (Risperdal) | 89.1 | 2 | Good |
| ODT15 | Lyophilized process tablets (ODTR008) | 88.3 | 3 | Good |
| ODT16 | Compressed process tablets (ODTR016) | 86.9 | 4 | Good |
| ODT17 | Negative control | 20.4 | 5 | Worst |

**RESULTS AND DISSCUSSION**

Tablets with lyophilization process having higher friability (>2%) may break during administration of patients, handling on machines and/or shipping (ODTR003, ODTR007 & ODTR008). The use of a lyophilzation process resulted in increased friability due insufficient hardness and more porosity nature. The disintegration time was found to be less than 20 seconds (USP limits for ODT is NMT 30 seconds) which made us to try compressed tablet approach.

Tablets with compressed tablet process having lower friability (<0.7%w/w) may not break during administration of patients, handling on machines and/or shipping (ODTR010, ODTR014, ODTR016 & ODTR017). The use of a compressed tablet process resulted in decreased friability due sufficient hardness. Tablets with compressed tablet process were shown less porosity than lyophilization process. Batch no. ODTR016 were shown faster disintegration and dissolution similar with reference product and lyophilization process tablets.

Total ten batches were selected and conducted for palatability evaluation study, in that one was reference (Risperdal) tablets (lyophilized process), one was positive control (which contain all ingredients except drug), three formulations (ODTR003, ODTR007 & ODTR008) were lyophilized test products, four formulations (ODTR10, ODTR014, ODTR016 & ODTR017) were compressed method test products and one formula was negative control (which contain all ingredients except taste masking agent and flavor enhancers like amberlite aspartame, acesulfame potassium and peppermint flavor).

The batches ODTR007 and ODTR008 were prepared using liquid peppermint flavor at different concentration to study its effect on patient acceptability in terms of flavor. The flavor concentration depended on the amount Peppermint Flavor present in tablets (1.25%, or 2.50%). The batches ODTR003 and ODTR008 were prepared using amberlite at different concentration to study its effect on patient acceptability in terms of taste masking. The batches ODTR016 and ODTR017 were prepared using powder peppermint flavor at different concentration to study its effect on patient acceptability in terms of flavor. The flavor concentration depended on the amount peppermint flavor present in tablets (1.0% or 0.5%). The batches ODTR010 and ODTR016 were prepared using amberlite at different concentration to study its effect on patient acceptability in terms of taste masking (2.0% and 3.0%). The batches ODTR014 and ODTR016 were prepared using acesulfame potassium as a taste enhancer at different concentration to study its effect on patient acceptability in terms of sweetness. The sweetener concentration depended on the amount acesulfame potassium present in tablets (1.5%, or 2.5%).

Formulation ODTR008 (Lyophilized process) and ODTR016 (Compressed tablets process) were prepared with 3.0% amberlite and volunteers acceptability of this formulation were significantly similar with positive control in terms of mouth feel, taste, flavor and disintegration. Formulation ODTR010 and ODTR003 were prepared 1: 3 ratio of drug Vs amberlite and volunteer's acceptability was significantly different with positive control in terms of mouth feel and taste. Formulation ODTR007 was prepared with 1.25% liquid peppermint flavor and acceptability was significantly different with positive control in terms of mouth feel, and flavor. Formulation ODTR017 was prepared with 0.5% powder peppermint flavor and acceptability was significantly different with positive control in terms of mouth feel and flavor. Formulation ODTR014 was prepared with 1.5% powder acesulfame potassium and acceptability was significantly different with positive control in terms of mouth feel and sweetness. Based on the patient evaluation study, taste masking agent, sweeteners and flavor enhancers were not sufficient in the formulation ODTR003, ODTR007, ODTR10, ODTR014 and ODTR017. The quantities were sufficient for formulation ODTR008 and ODTR016 (Table 18A, 18B, Fig. 1 and Fig. 2). Hence for risperidone ODT, formulation ODTR008 (lyophilization process) and ODTR016 (Compression tablet process) were finalized for further biostudy.

Total five batches were selected for final palatability evaluation study, in that one was reference (Risperdal) tablets (lyophilized process), one was positive control (which contain all ingredients except drug), one formulation was (ODTR008) lyophilized test product, one formulation (ODTR016) was compressed method test product and one formula was negative control (which contain all ingredients except taste masking agent and flavor enhancers like amberlite aspartame, acesulfame potassium and peppermint flavor). In that positive control shown maximum score (Rank 1), Negative control shown least score (Rank 5), Lyophilized process test product and compressed method test product were similar results with reference (Risperdal) product interms of taste, flavor, mouth feel, sweetness and overall acceptability. Based on the above palatability evaluation study of both lyophilization process and compressed method process, were similar for palatability by volunteers.

The results shown in Table 18A, 18B, 18C, Fig. 1, Fig. 2 & Fig. 3 indicate that concentration dependent acceptability was observed in batches prepared using peppermint flavor as a flavor enhancing agent, acesulfame potassium as a sweetener and Amberlite as a taste masking agents are responsible for good acceptability by volunteers. It is worthwhile to note that as the concentration of Amberlite increased up to 3%, the acceptability also increased. Lyophilization process showed better acceptability than compared with Compressed tablets process because less DT and contain more porous nature, but significantly not much effect (Table 18C & Fig. 3).

**Overall summary report of taste evaluation study**

Table 18A:

| **Sr. No.** | **Formulation** | Calculated points | **Overall Ranking** | Acceptability |
|---|---|---|---|---|
| 1 | Positive control | 99.4 | 1 | Very Good |
| 2 | Reference (Risperdal) | 91.1 | 2 | Very Good |
| 3 | In house tablets (ODTR003) | 61.2 | 5 | Acceptable |
| 4 | In house tablets (ODTR007) | 75.6 | 4 | Acceptable |
| 5 | In house tablets (ODTR008) | 91.1 | 2 | Very Good |
| 6 | Negative control | 20.3 | 6 | Worst |

Table 18B:

| **Sr. No.** | **Formulation** | Calculated points | **Overall Ranking** | Acceptability |
|---|---|---|---|---|
| 1 | Positive control | 99.4 | 1 | Very Good |
| 2 | In house tablets (ODTR010) | 59.6 | 5 | Poor |
| 3 | In house tablets (ODTR014) | 78.2 | 4 | Acceptable |
| 4 | In house tablets (ODTR016) | 90.2 | 2 | Very Good |
| 5 | In house tablets (ODTR017) | 78.4 | 3 | Acceptable |
| 6 | Negative control | 20.3 | 6 | Worst |

Table 18C:

| **Sr. No.** | **Formulation** | Calculated points | **Overall Ranking** | Acceptability |
|---|---|---|---|---|
| 1 | Positive control | 97.6 | 1 | Very Good |
| 2 | Reference (Risperdal) | 89.1 | 2 | Good |
| 3 | Lyophilized process tablets (ODTR008) | 88.3 | 3 | Good |
| 4 | Compressed process tablets (ODTR016) | 86.9 | 4 | Good |
| 5 | Negative control | 20.4 | 5 | Worst |

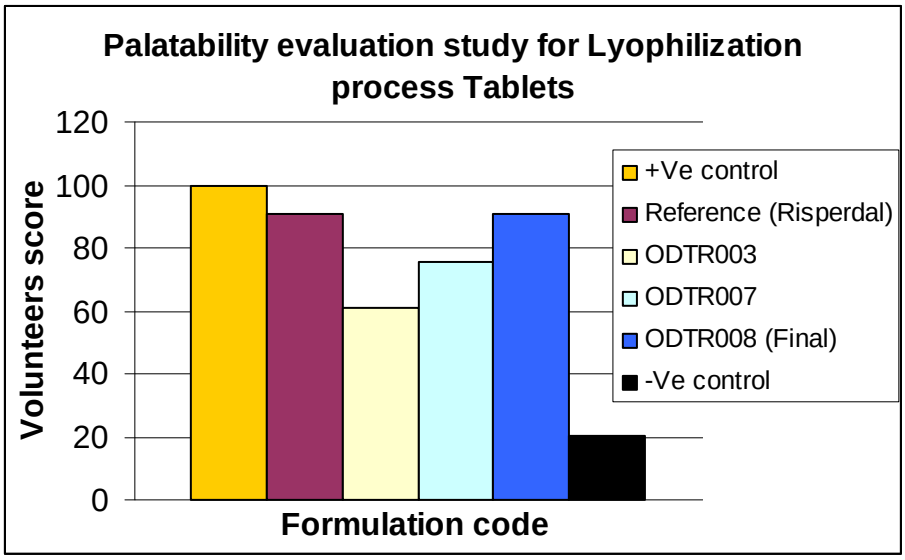


Fig 1: Graphical representation of Palatability evaluation study report for Lyophilization process tablets

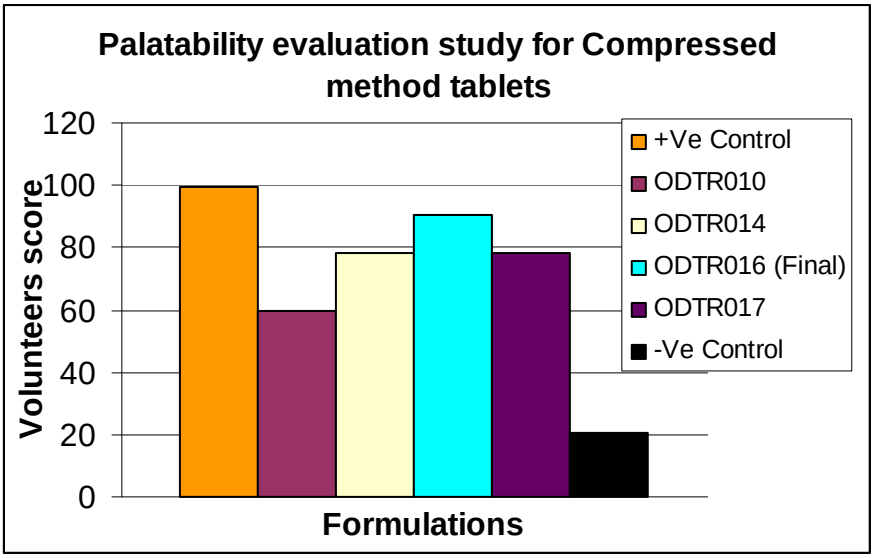


Fig 2: Graphical representation of Palatability evaluation study report for compressed process tablets

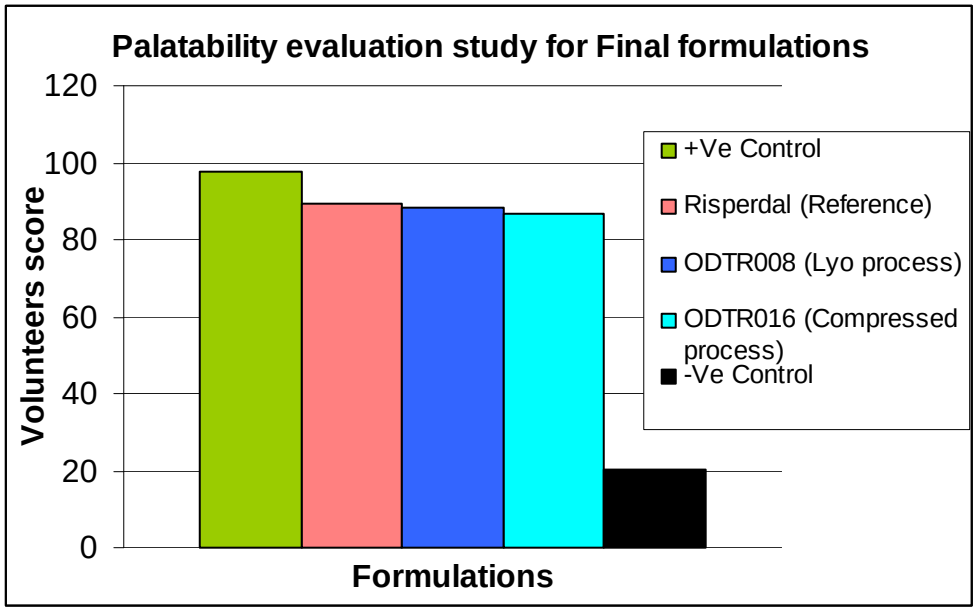


Fig 3: Graphical representation of Palatability evaluation study report for both Lyophilization & Compressed process (Final formulations) tablets

## CONCLUSION

Oral disintegrating tablets (ODT) of risperidone were successfully prepared by using both lyophilization and compressed tablet process. Undoubtedly the availability of various technologies and the manifold advantages of ODT will surely enhance the patient compliance, low dosing, and rapid onset of action, fast disintegration, low side effect, good stability and its popularity in the near future. Based on the above data lyophilization process final tablets and compressed tablet process final tablets were similar with the reference product in terms of palatability by volunteers. From the study, it can be concluded that the compressed tablet process was similar with lyophilization process in terms of taste. Based on the study, first rank allotted for positive control (maximum score) and last rank allotted for negative control (minimum score). Reference product, finalized lyophilization formulation and finalized compressed method formulation were observed similar score (Table 17C), there is no significant difference on the palatability evaluation for both the process. Taste masking agent and flavor were played major role in palatability for both lyophilization method and compression method (Table 17A & 17B). Compressed method process is very cheap, effective, easy to pack the tablets, easy to take the tablet from the pack, easy to transport, more stable and normal storage conditions are sufficient. Tablets manufactured using lyophilzation exhibited low hardness, difficulty in packing, required special storage and transportation condition, and difficult to take tablet from the pack. Compressed tablet process would be an effective, low cost and simple alternative approach compared with the use of more expensive process like lyophilization and adjuvant in the formulation of oral disintegrating tablets.

Hence, based on the palatability evaluation study results by volunteers were observed, the method chosen for palatability evaluation study was correct. So, for palatability evaluation of ODT formulations, above method is most suitable method.

## References

[1] Adjei, A, Doyle R., Reiland, T., In Swarbrick, J., Boylan, J.C., Eds; Encyclopedia of Pharmaceutical Technology, Vol.6, Marcel Dekker, New York, 1992, 117.
[2] Billany, M.R.J. In; Aulton M.E., Eds; Pharmaceutics; The science of Dosage form Design, International Edition, Churchill Livingstone, New York, 1996, 263.
[3] Lindgren S, Janzon L. Prevalence of swallowing complaints and clinical findings among 50-79-year-old men and women in an urban population. Dysphagia.1991; 6: 187–192. doi:10.1007/BF02493524
[4] Hanawa T. New oral dosage form for elderly patients: preparation and characterization of silk fibroin gel. Chem Pharm Bull. 1995; 43: 284–288. PMid:7728934
[5] Gisel EG. Oral motor skills following sensorimotor intervention the moderately eating impaired child with cerebral palsy. Dysphagia.1994; 9: 180–192. doi:10.1007/BF00341263

[6] Virely P, Yarwood R. Zydis - a novel, fast dissolving dosage form. Manuf Chem. 1990; 61: 36–37.
[7] Pebley WS, Jager NE, Thompson SJ. Rapidly disintegrating tablet. US Patent 5, 298, 261. 1994 March 29.
[8] Watanabe Y. New compressed tablet rapidly disintegrating in the mouth using crystalline cellulose and a disintegrant. Biol Pharm Bull. 1995; 18: 1308–1310. PMid:8845832
[9] Myers GL, Battist GE, Fuisz RC. Process and apparatus for making rapidly dissolving dosage units and product there from. PCT Patent WO 95/34293-A1.1995 Dec 21.
[10] Allen LV, Wang B. Process for making a particulate support matrix for making a rapidly dissolving tablet. US Patent 5,587,180. 1996 Dec 24. Mouth Dissolving Tablets II: An Overview of Evaluation Techniques 339 Sci Pharm. 2009; 77; 327–341.
[11] Koizumi KI, Watanabe Y, Morita K, Utoguchi N, Matsumoto M. New method for preparing high porosity rapidly saliva soluble compressed tablets using mannitol with camphor, a subliming material. Int J Pharm. 1997; 152: 127–131. doi:10.1016/S0378-5173(97)04924-7
[12] Bhaskaran S, Narmada GV. Rapid dissolving tablet a novel dosage form. Indian Pharmacist. 2002; 1: 9–12.
[13] Elan Corporation, plc. Orally disintegrating tablets (ODT) – NanomeltTM http://www.elan.com/EDT/nanocrystal%5Ftechnology/orally_disintegrating_tablet.asp.
[14] Bess WS, Kulkarni N, Ambike SH, Ramsay MP. Fast dissolving orally consumable solid film containing a taste masking agent and pharmaceutically active agent at weight ratio of 1:3 to 3:1.
[15] US Patent 7067116. 2006 Jun 27.